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SHPHUL USER'S MANUAL
(VERSION II)

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CONTRACTOR REPORT

Prepared for

Defence Research Establishment Atlantic

Centre de Recherches pour la Défense Atlantique

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Abstract

SHPHUL generates finite element models of a ship hull from body plan coordinates. The model is generated by dividing the hull into a number of sections based on groupings of the body plan contour lines displayed on a terminal screen. Each section is modelled by the use of 4 or 12 noded panels. The 4 noded panels can be skewed or warped between body plan lines. Curvature is represented by the use of the 12 noded panels. The nodes are located with a terminal cursor after body plan contours are selected and displayed on the terminal screen. The panels are then gridded with predefined beams representing frames and longitudinal beams and triangular or rectangular plate elements. Each gridded panel can be made a substructure. Then each hull section is formed as a series of substructures. Transverse and longitudinal bulkheads are formed in a similar manner. Each panel is reduced to master nodes at section boundaries. All the sections are assembled to form the total hull model. An option within the program will generate each section and bulkhead as an individual unsubstructured finite element model which can be assembled later as a single total structural model. The finite element model files created are in the format required by the finite element program VAST thus enabling a structural analysis to be performed as defined by the loading conditions. SHPHUL can generate hydrostatic pressure loads due to still water and balance-on -a-wave waterlines. Boundary conditions can be applied and three types of added fluid mass model can be created for the hull. This report includes a user's manual and example terminal sessions.

Résumé

SHPHUL génère des modèles à éléments finis de la coque d'un navire à partir des coordonnées du plan de la carène. Le modèle est généré par la division de la coque en un certain nombre de sections, selon les groupements des lignes de contour du plan de la carène, qui sont affichés sur un écran de terminal. Chaque section est modélisée au moyen de panneaux à 4 ou 12 noeuds. Les panneaux à 4 noeuds peuvent être inclinés ou recourbés entre les lignes du plan de la carène. La courbure est représentée par des panneaux à 12 noeuds. Les noeuds sont localisés au moyen d'un curseur du terminal, une fois que les contours du plan de la carène ont été sélectionnés et affichés à l'écran. Les panneaux sont ensuite divisés en grille, au moyen d'éléments prédéfinis représentant le bâti, d'éléments longitudinaux et de plateaux trianglulaires ou rectangulaires. Chaque panneau grillagé peut être transformé en sous-structure. Chaque section de la coque est ensuite formée d'une série de sous-structures. Les cloisons étanches transversales et longitudinales sont formées de façon semblable. Chaque panneau est réduit à des noeuds principaux aux limites des sections. Toutes les sections sont assemblées pour former le modèle total de la coque. Une option du programme génère chaque section et cloison étanche sous forme de modèle particulier d'éléments finis non sous-structurés, qui peut être assemblé ultérieurement en un seul modèle structurel total. Les fichiers créés du modèle à éléments finis sont dans le format qu'exige le programme à éléments finis VAST, ce qui permet d'effectuer une analyse structurelle selon la définition des conditions de charge. SHPHUL peut générer les charges de pression hydrostatique créées par les lignes de flottaison en eau calme et en état de balancement sur les vagues. Il est possible d'appliquer des conditions limites et de créer trois types de modèle à masse fluide ajoutée. Ce rapport comprend un manuel de l'utilisateur et des exemples de sessions au terminal.

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Chapter 1

Introduction

SHPHUL generates finite element models of a ship hull, in the data format of the finite element program VAST[1], from a body plan by using coordinates from the plan obtained by one of four methods. The first is by manual input from measurements of a body plan drawing. The second is by digitizing the body plan drawing using a digitizing tablet. The third is by producing a body plan coordinate file with a CRT terminal screen by using the screen cursor to pick off the desired coordinates on a grid. The fourth is a data file supplied in the required data format from an external source. The model is generated by dividing the hull into a number of sections based on groupings of body plan contour lines. For example a hull section might be composed of the first four body plan curves. These curves are then used to obtain coordinates of the model with the terminal screen cursor. Each section is modelled by the use of 4 or 12 noded panels shown in Figure 1.1. The 4 noded panels can be skewed or warped between the body plan lines. If curvature is to be represented the 12 noded panel must be used. The panelled sections can then be assembled and gridded with beams and plates to model the complete hull as shown in Figure 1.2.

The panels are most conveniently fitted to the hull outline in a clockwise direction, when view from the outside, starting at the hull center line at the weather deck, see Figure 1.3. The datum is the forward perpendicular and the lowest point on the keel. For a panel of any hull section the most forward coordinates are entered first, see Figure 1.4. The number of panels is dependent on the complexity of the geometry to be modelled and the location of attached structure such as decks. Because beams are usually involved in the finite element modelling the direction of the beam orientation must be considered. This is achieved by generating normals to the panels at beam node locations. If the normals are to face inwards then the panel nodal coordinates must be entered in a counter clockwise direction when looking at the panel from the inside, see Figure 1.5.

Once the panels have been generated they are stored on a file. There is a file FRAME.DXX

for each hull section. Each panel of a section can be gridded with plate and beam elements representing the hull plating, frames, and the fore and aft beams, by the use of shape functions[2]. These can be displayed graphically for inspection. When the adjoining section is modelled the panel nodes from the previous section are displayed to ensure that the fore and aft beams for ajacent sections line up.

A file of beams, BEAMS.DAT, used in modelling the frames and fore and aft beams, is created by prompting from SHPHUL. A considerable amount of data is required to meet the beam specifications of the finite element program VAST including eccentricity from the neutral axis.

The basic panel data is the source from which the mesh of plate and beam elements is generated. It is possible to have uneven or evenly spaced beams. The grillage produced is made up of triangular or rectangular plate elements surrounded by two frames and two longitudinal beams. This is a coarse grid which is not fine enough for determining accurate plate stresses or beam bending between frames. A four by four grid of plate elements within the region bounded by the frames and longitudinal beams would be required. For this reason there is an option in SHPHUL to increase the number of plate elements between beams.

At any stage of the modelling process the sections gridded with beams and plates can be converted to substructured models where each panel of each section is treated as a substructure. The substructures are listed as a series of individual panel files named SXXXX which identify the section and the panel of the section. For example S0308 refers to hull section 3 and panel 8. A list of the file names is stored under file name SHPHL.DAT. The files themselves are SXXXX.GOM which are basic geometry and element connectivity files. These geometry files can then be processed to create substructures for use by the finite element program VAST and the model display program VASTG[3]. To create the substructures from each gridded panel and equivalence the shared panel nodes the SXXXX.GOM files are run through the program UNITE which produces a substructure file SUBSH.

Another option during the modelling process is to create a VAST finite element file for each of the sections. These files can then be assembled, by using the program VASGEN[4], to form a single large finite element model. In this way a large coarse model can be analysed as the preliminary step to the top-down method of analysis. With this method a detailed analysis can be conducted by extracting a region of the large coarse model. Boundary conditions in the form of prescribed displacements , obtained from the preliminary analysis, are applied to the boundaries of the extracted region. The coarse grid is refined to the degree required, by the use of the refining option in the program VASFEM[5], to obtain the detailed stresses in the structure. The top-down process is illustrated in reference[6].

The models created by SHPHUL can be displayed graphically at various stages either by routines within the program or by external programs such as VASTG and PATRAN[4].

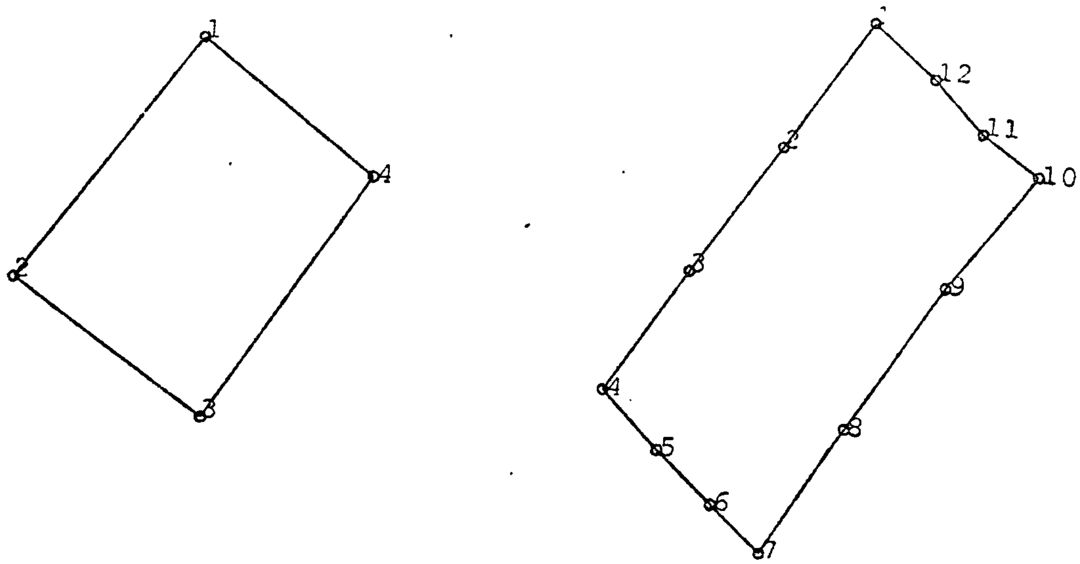


Figure 1.1: The 4 And 12 Noded Quadrilateral Panels Used In SHPHUL

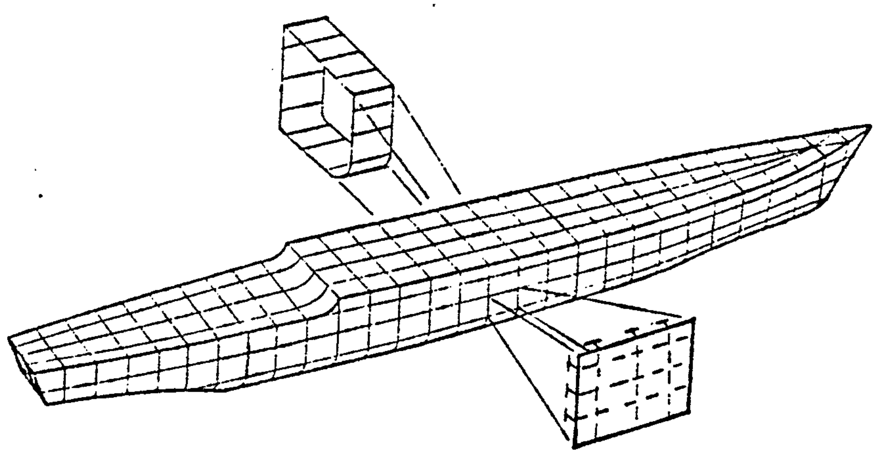


Figure 1.2: An Assembly Of Panelled Sections Forming A Complete Hull

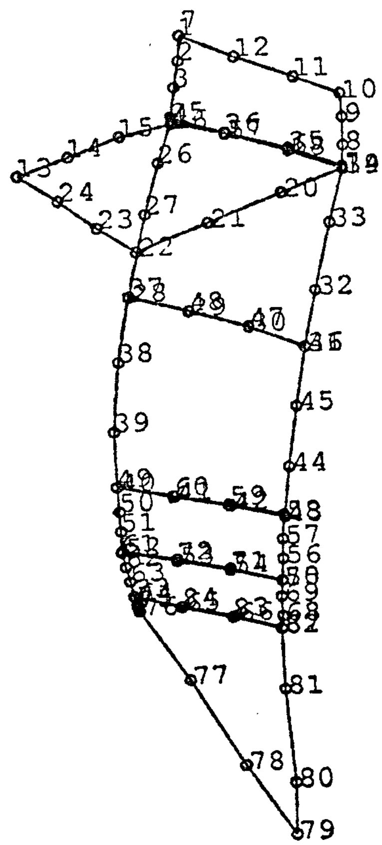


Figure 1.3: The Clockwise Direction For Defining The Hull Panels

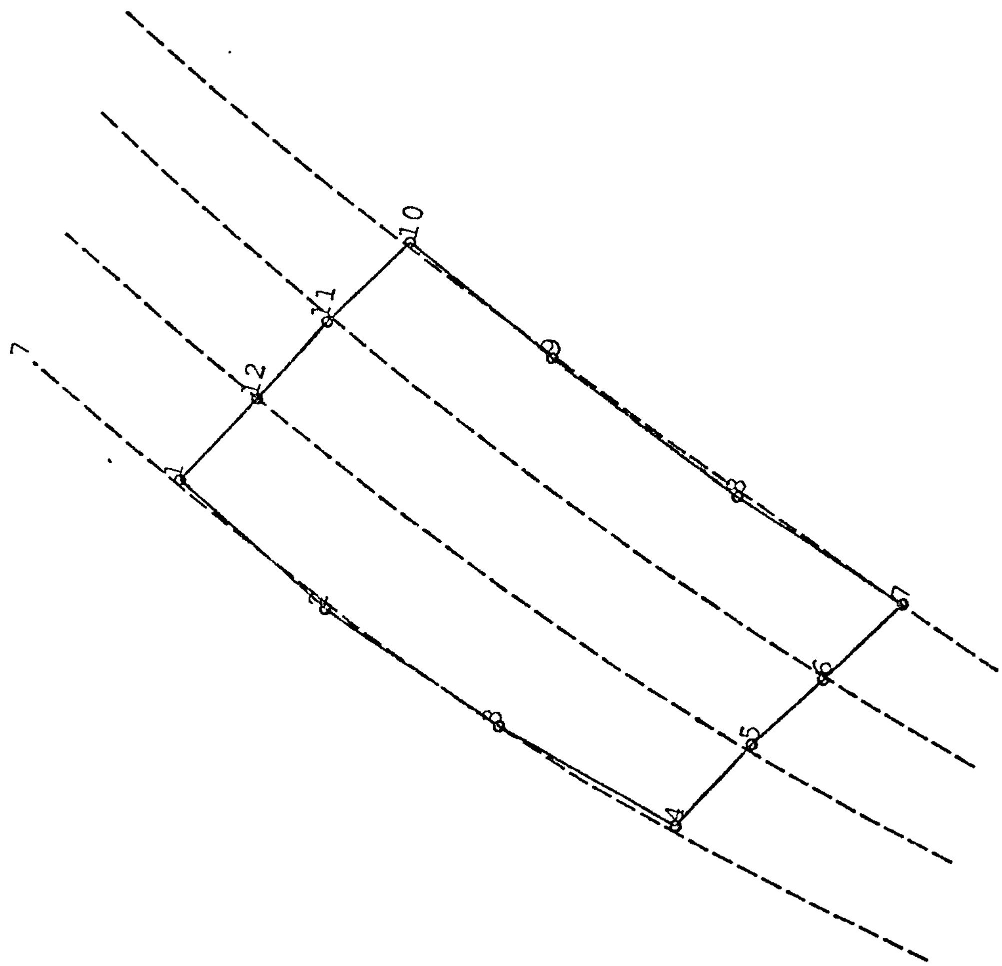


Figure 1.4: The Sequence Of Node Location For The Panels

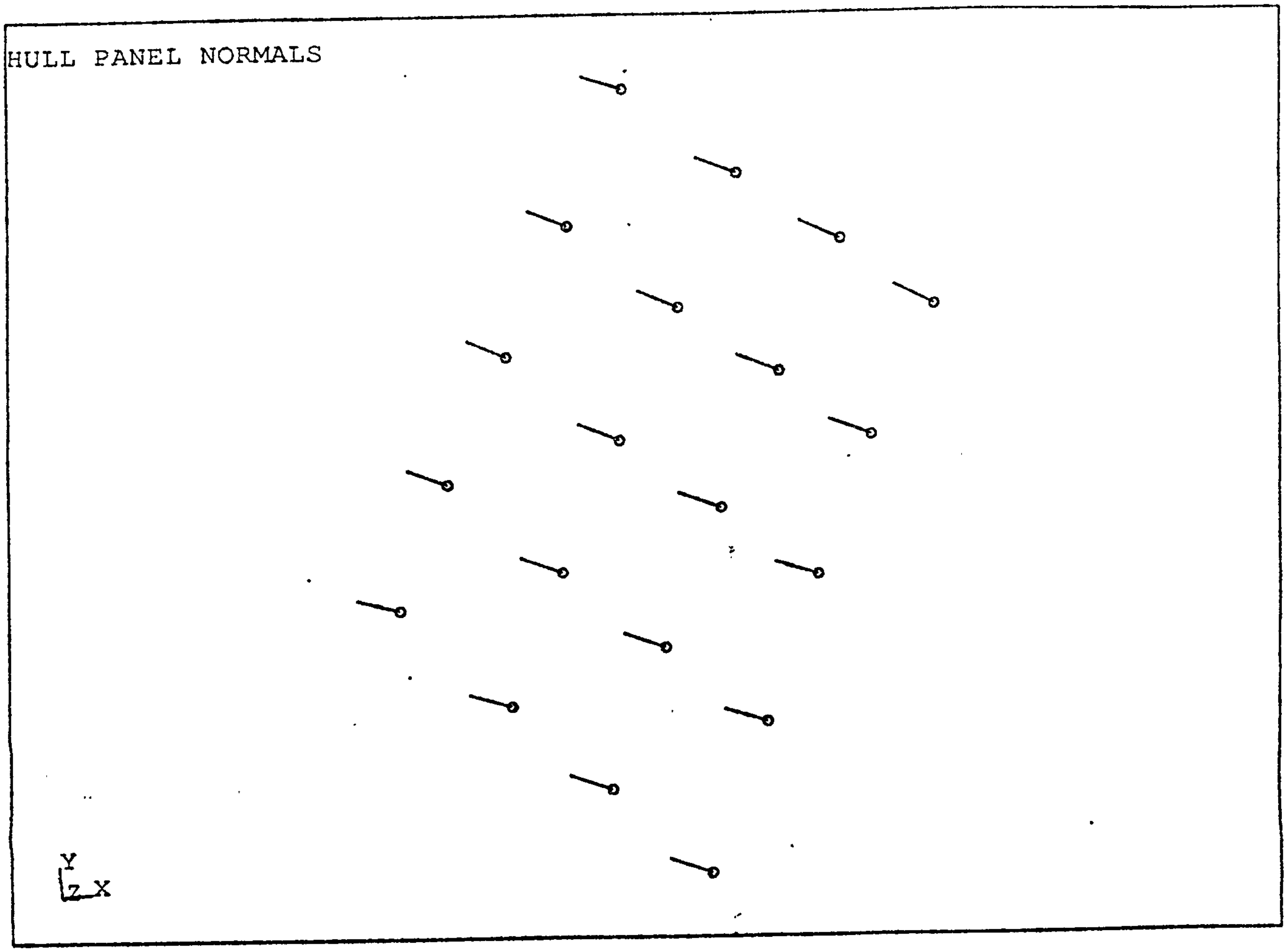


Figure 1.5: Normals To The Panel At The Nodes From A Counter Clockwise Sequence

Chapter 2

Theoretical Basis

SHPHUL is built around 4 and 12 noded quadrilateral panels. The panels have a parent quadrilateral with shape functions[2] which allows interpolation throughout the panels using a natural coordinate system s,t. The coordinate system allows points within the quadrilateral to be located whose values never exceed unity as shown in Figure 2.1. The corner nodes all have positive or negative values of unity as their coordinates. The shape function are such that the substitution of the natural coordinates of any of the corner nodes results in the value 1 being produced. In using this system it is convenient to consider two quadrilaterals. The parent quadrilateral is dimensioned in natural coordinates and the hull panel quadrilateral is dimensioned in real units as shown Figure 2.2. When the matrix of the panel node coordinates is multiplied by the matrix of the natural coordinate shape functions, including a desired point within the parent quadrilateral, the results are the coordinates of the equivalent point in the hull quadrilateral. In this manner by gridding the parent panel a suitably proportioned grid of points is established on the hull panel which can be used to locate beams and form plate elements. The matrix equation for the process is;

$$\left\{ \begin{array}{c} X \\ Y \\ Z \end{array} \right\} = [N] \begin{array}{c} \{x\} \\ \{y\} \\ \{z\} \end{array} \tag{2.1}$$

where
[N] is the array of shape functions
$\{x\}$
$\{y\}$ are the hull panel coordinates for the 12 exterior nodes
$\{z\}$

$\left\{ \begin{array}{c} X \\ Y \\ Z \end{array} \right\}$ are the resulting coordinates of the interpolated points on the hull panel.

2.1 Panel Shape Functions

The shape functions for the four noded parent quadrilateral are;

$$N_i = \frac{1}{4}(1 + ss_i)(1 + tt_i) \tag{2.2}$$

where s and t are the interpolation points in the parent element and s_i and t_i are the nodal values of the corner nodes.

The shape functions for the 12 noded parent quadrilateral are for the corner nodes;

$$N_i = \frac{1}{32}(1 + ss_i)(1 + tt_i)9[(s^2 + t^2) - 10] \tag{2.3}$$

where s_i and t_i are the nodal values of the corner nodes and s and t are the local coordinates of a point within the quadrilateral.

The shape functions for nodes at the $\frac{1}{3}$ points are

$$N_i = \frac{9}{32}(1 - s^2)(1 + 9ss_i)(1 + tt_i) \tag{2.4}$$

for $s_i = \pm\frac{1}{3}$, $t_i = \pm 1$ as determined by the $\frac{1}{3}$ node point locations.

In SHPHUL the 4 and 12 nodes of a hull panel are located by the user with the terminal cursor. The $\frac{1}{3}$ points should be located as close to the true values as possible to ensure accurate interpolation of the finite element grid. To simplify the programing the shape functions for the 12 node quadrilateral are also used for the 4 node quadrilateral. The extra 8 nodes are obtained by linear interpolation between the corner nodes.

2.2 Normals To Panel Grid Points

The local axis system used for the orientation of beams attached to the hull panels, as frames and longitudinal beams, is shown in Figure 2.3. The beam local Y axis at the node is the local normal to the panel. It is therefore necessary to determine these normals at the beam nodes to ensure the correct orientation of the stiffness axes of the beams. SHPHUL in subroutine NODGEN computes these normals with the option to display them graphically. The graphic display shows the beam local Y axis and the side of the panel to which the beams are attached. To place the beams on the inboard side of the outer the panels, the 12 geometric

perimeter nodes must be located in a counter clockwise sequence when looking outwards.(see Figure 2.4)

The normals are determined by taking the cross product of the tangent vectors to the panel surface at the grid points. The tangent vectors for the 12 node panel are;

$$V_s = \left[\frac{\delta N}{\delta s}\right] \begin{matrix}\{x\}\\ \{y\}\\ \{z\}\end{matrix} \tag{2.5}$$

$$V_t = \left[\frac{\delta N}{\delta t}\right] \begin{matrix}\{x\}\\ \{y\}\\ \{z\}\end{matrix} \tag{2.6}$$

where for the corner nodes

$$\frac{\delta N_i}{\delta s} = \frac{1}{32}(1 + tt_i)(s_i(27s^2 + 9t^2 - 10) + 18s) \tag{2.7}$$

and

$$\frac{\delta N_i}{\delta t} = \frac{1}{32}(1 + ss_i)(t_i(9s^2 + 27t^2 - 10) + 18t) \tag{2.8}$$

and for the $\frac{1}{3}$ points where $s_i = \pm 1, t_i = \pm\frac{1}{3}$

$$\frac{\delta N_i}{\delta s} = \frac{9}{32}s_i(1 + 9tt_i)(1 - t^2) \tag{2.9}$$

$$\frac{\delta N_i}{\delta t} = \frac{9}{32}(1 + ss_i)(-27t^2t_i - 2t + 9t_i) \tag{2.10}$$

and where $s_i = \pm\frac{1}{3}, s_i = \pm 1$

$$\frac{\delta N_i}{\delta s} = \frac{9}{32}(1 + tt_i)(-27s_is^2 - 2s + 9s_i) \tag{2.11}$$

$$\frac{\delta N_i}{\delta t} = \frac{9}{32}t_i(1 + 9ss_i)(1 - s^2) \tag{2.12}$$

Expanding the matrix equations 2.5 and 2.6

$$\frac{\delta x}{\delta s} = \left[\frac{\delta N}{\delta s}\right] \{x\} \tag{2.13}$$

$$\frac{\delta y}{\delta s} = \left[\frac{\delta N}{\delta s}\right] \{y\} \tag{2.14}$$

$$\frac{\delta z}{\delta s} = \left[\frac{\delta N}{\delta s}\right] \{z\} \tag{2.15}$$

$$\frac{\delta x}{\delta t} = \left[\frac{\delta N}{\delta t}\right] \{x\} \tag{2.16}$$

$$\frac{\delta y}{\delta t} = \left[\frac{\delta N}{\delta t}\right] \{y\} \tag{2.17}$$

$$\frac{\delta z}{\delta t} = \left[\frac{\delta N}{\delta t}\right] \{z\} \tag{2.18}$$

The normals at a grid point are

$$X_n = \frac{\delta y}{\delta s}\frac{\delta z}{\delta t} - \frac{\delta y}{\delta t}\frac{\delta z}{\delta s} \tag{2.19}$$

$$Y_n = -\frac{\delta x}{\delta s}\frac{\delta z}{\delta t} + \frac{\delta x}{\delta t}\frac{\delta z}{\delta s} \tag{2.20}$$

$$Z_n = \frac{\delta x}{\delta s}\frac{\delta y}{\delta t} - \frac{\delta x}{\delta t}\frac{\delta y}{\delta s} \tag{2.21}$$

where X_n,Y_n and Z_n are the coordinates of the end point of the normal.

An example of the normals to a grided panel is shown in Figure 2.5.

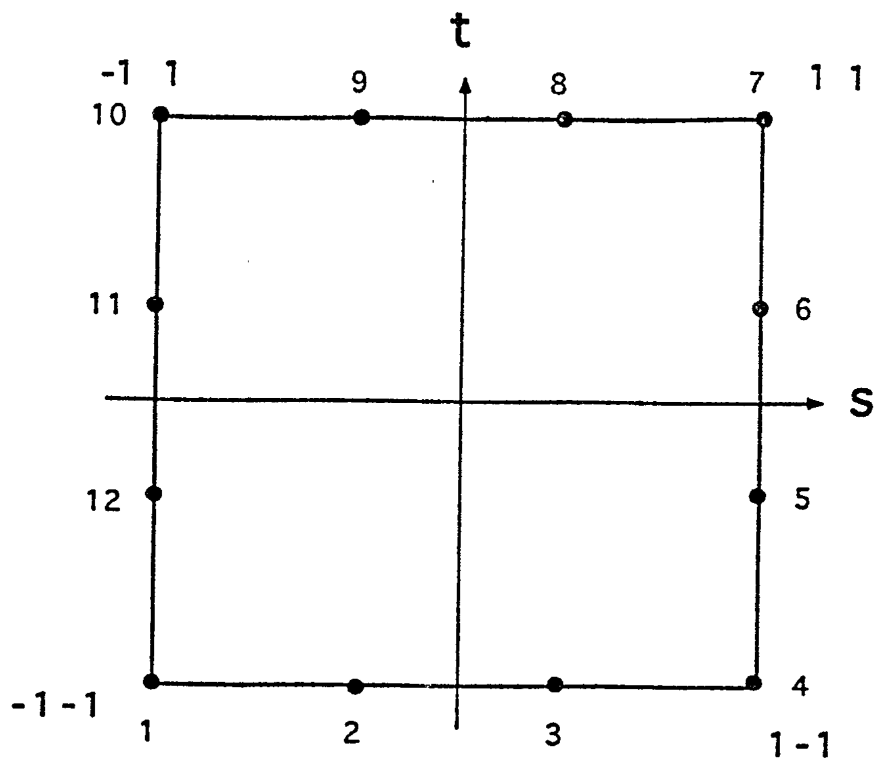


Figure 2.1: Quadrilateral With s And t Natural Coordinates

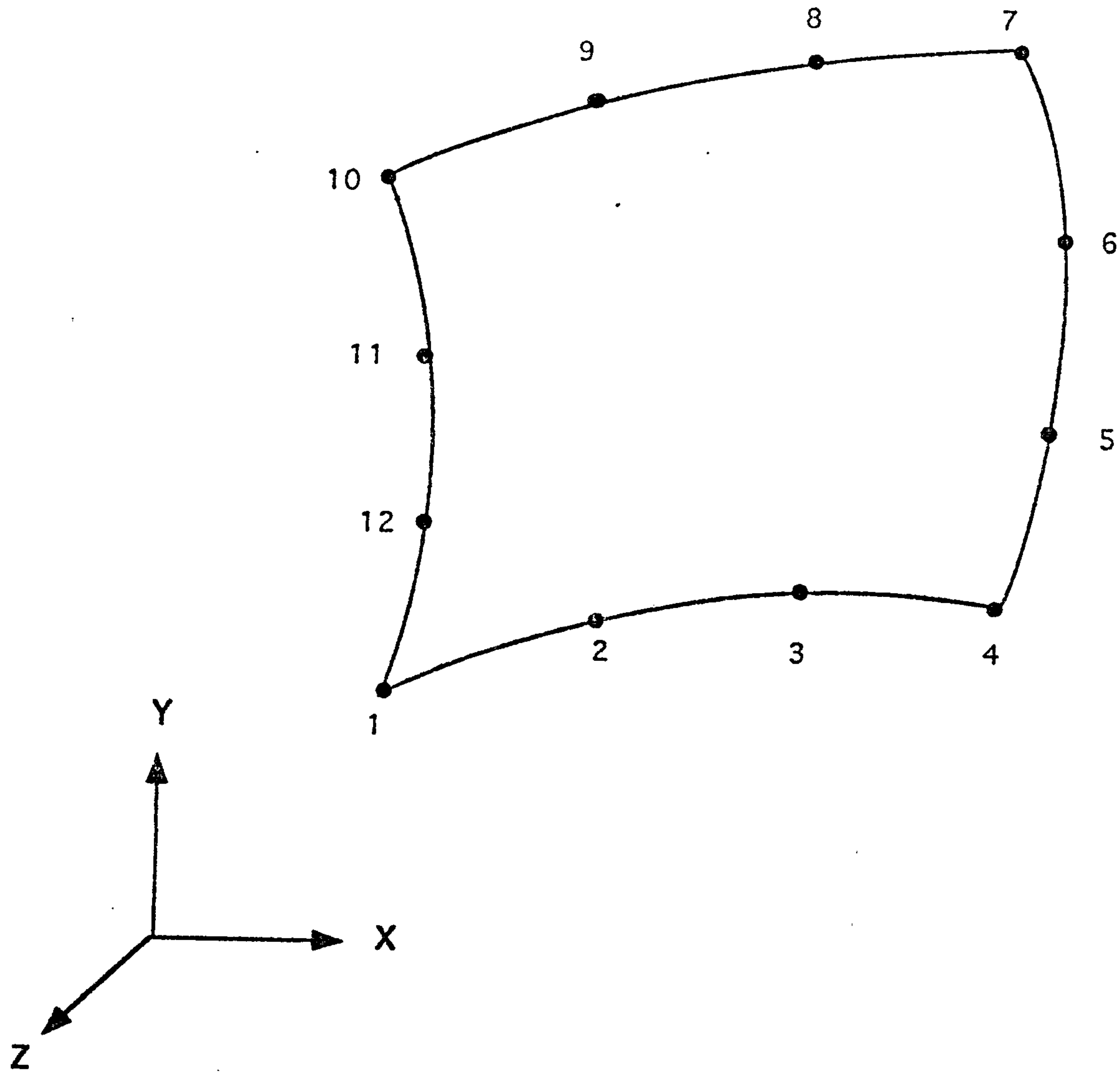


Figure 2.2: Hull Panel External Real Coordinates

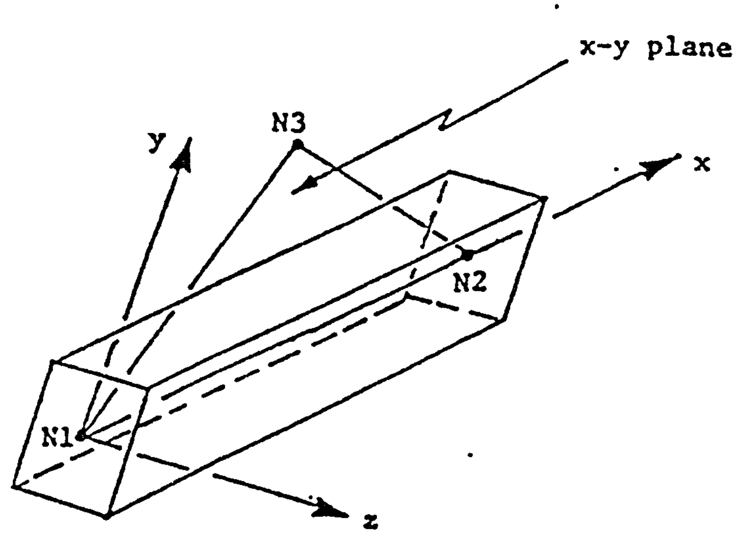


Figure 2.3: Local Axis System For Beams Attached To The Hull Panel

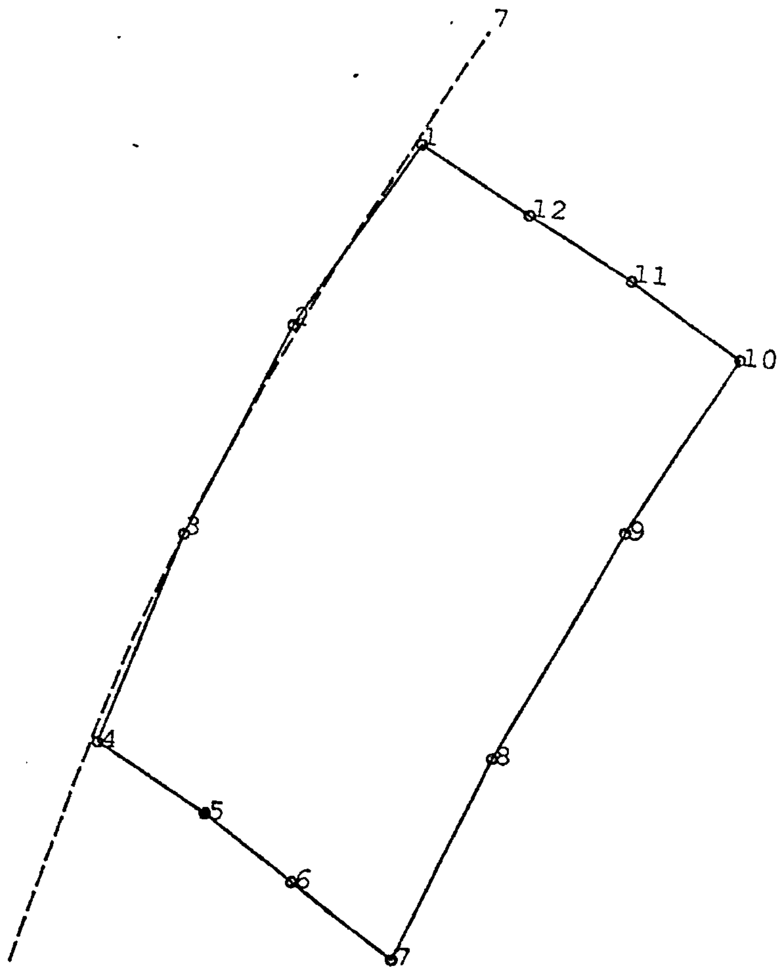


Figure 2.4: Node Numbering Sequence To Place Beams On Inside Of Hull Side Panel

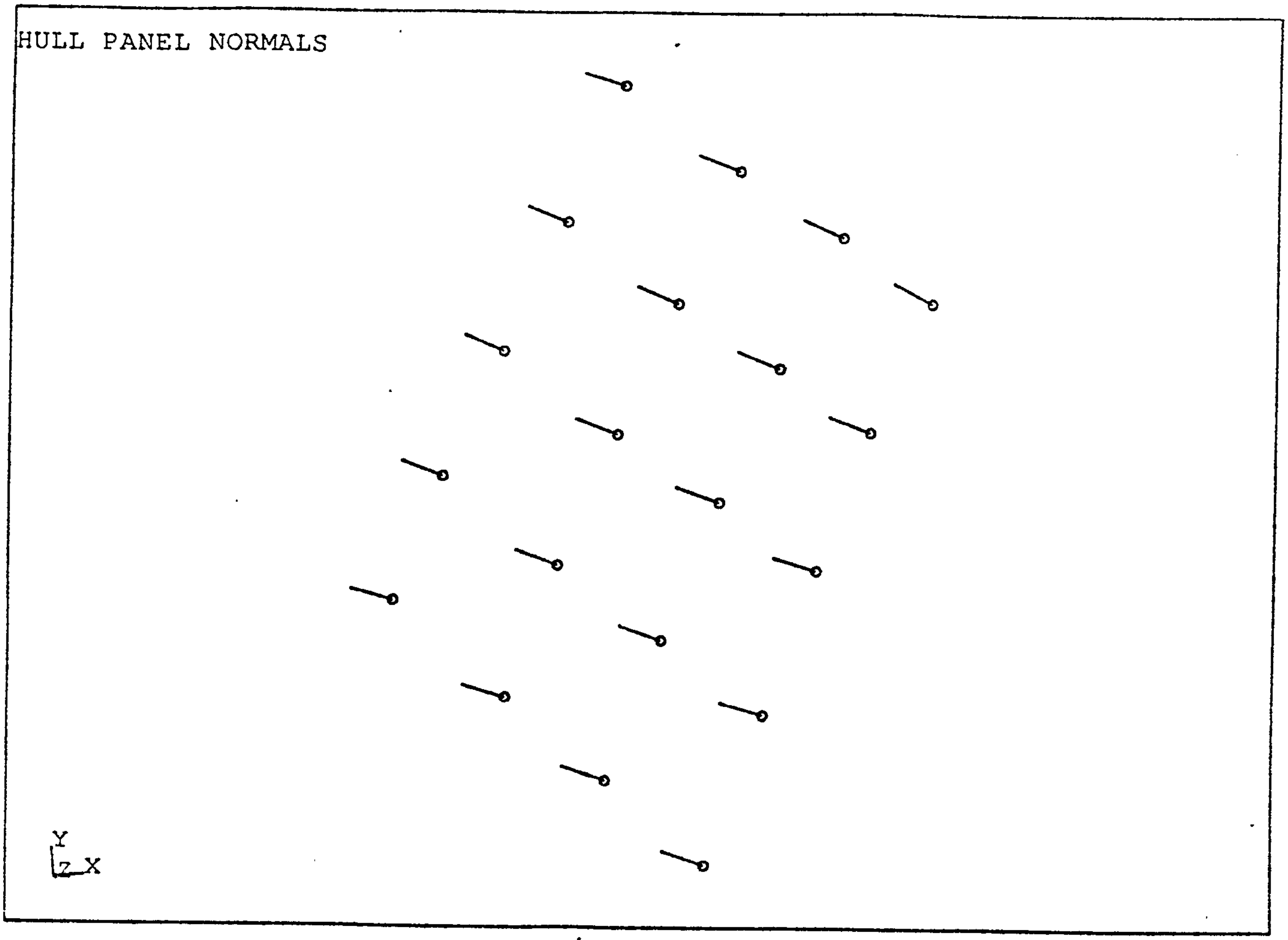


Figure 2.5: Normals To A Gridded Hull Panel

Chapter 3

Program Organization

SHPHUL is organized as a suite of subroutines with which the finite element model is generated. The model building blocks are the 4 and 12 node panels which are used to form the hull sections and bulkheads. The panels are created by superimposing them on an assembly of body plan contours with the use of the terminal cursor to locate the 4 or 12 panel external nodes. The panels can be treated as first level substructures in each of the sections. The sections are assembled to form the hull model. An option within the program will form the sections as assemblies of unsubstructured panels in the form of VAST geometry and plate and beam element connectivity files. Each of these can be analysed individually or assembled into a large hull model. Generally only a half model is generated which can be mirrored to form a full three dimensional model of the hull. The detailed organization of the program is best outlined through a description of the subroutines.

3.1 Subroutines

SUBROUTINE BODYPLAN allows a new bodyplan to be generated from the original. Generally the 21 stations of the typical bodyplan do not coincide with the frame spacing which is a requirement of SHPHUL. With this subroutine the new bodyplan can be generated to meet this requirement as well as any other rearrangement of the bodyplan that is useful in the modelling of the hull, such as the location of the start and end of the superstructure. The new bodyplan must be arranged so that any group of 4 plan lines can be automatically divided into frame spacing increments by SHPHUL. To achieve this the beginning and ending lines of the 4 lines must fall on frame locations.

SUBROUTINE BMPROP is used for inputing beam properties which are stored in file BEAMS.DAT. The subroutine prompts the user for the beam data required by VAST. The beam data required is described in subsection 3.2.2. A library of beam elements is generally

created depending on the number of beam sizes used in the ship structure.

SUBROUTINE PBODY is used for the terminal generation of panels from selected bodyplan contours and allows plotting of the bodyplan for reference. File PANEL.DAT stores the data created by this subroutine.

SUBROUTINE HULL grids the panels, controls the generation and plotting of hull structural panels. It requires files PANEL.DAT and FRAME.DXX. It also controls editing of the model, display of panel normals, the creation of a substructured model, the generation of a VAST file for the model, and the application of hyrostatic pressure loads to the model.

SUBROUTINE NODGEN called from HULL, generates a grid on the panels with shape functions. The grid is used as the basis for forming a grillage of beams and plate elements. It also generates normals to the panel at the nodes to identify the orientation of the beams. The grid data is stored on file MODEL.DAT.

SUBROUTINE GNORM called from HULL plots the normals on the panels.

SUBROUTINE GRAPH called from HULL displays panel grillage of beams and plates.

SUBROUTINE BEAMV called from HULL generates beam connectivity and orientation for one panel at a time and eliminates duplicate beams at panel shared edges to create a single unsubstructured model of a section of the hull formed from the panels.

SUBROUTINE BULK called from the main program creates transverse and longitudinal bulkheads. The transverse bulkheads are located at existing frame locations selected by the user. The panels are generated by cursor input on a graphic display of the hull crossection. Only half the bulkhead need be generated as it can be mirror imaged later.

SUBROUTINE PBULK called from BULK plots the hull section at the desired bulkhead location. The panels forming the bulkhead are created by locating the nodes with the terminal cursor.

SUBROUTINE PEDIT is called from the MAIN program and is prompted for in HULL. It provides for the editing of the basic panel coordinates with the terminal cursor. The basic panel is displayed on the screen with the nodes numbered. A node is relocated by entering its number then identifying its new position with the screen cursor.

SUBROUTINE EQUIV is called from HULL and equivalences panel nodes of a section along shared edges.

SUBROUTINE IMAGE called from the main program can be used to create a full hull section or bulkhead from a half section of panels.

SUBROUTINE SUBSTR is called from HULL to create a series of substructures from the panels assembled to form a hull section. Each gridded panel is treated as an individual substructure. The subtructure file SHPHL.GOM is written along with file SHPHL.SED which identifies the master nodes of the substructure.

SUBROUTINE BEAMSB is called from SUBSTR to generate the beam connectivity and beam orientation for each panel. Duplicate beams are eliminated and beam data is written on the substructure geometry file.

SUBROUTINE GUNITE is called from HULL to create a list of substructure geometry files, one for each panel of the section. The list is stored on SHPHL.DAT to be read by the program UNITE.MAR. The individual substructures, which are SXXXX.GOM files, are created by GUNITE which can also be used to create a list of substructure geometry BXXXX.GOM files stored on SHPBM.DAT. GUNITE will also create the BXXXX.GOM files themselves, which are used for duplicate beam checking.

SUBROUTINE BEAMCK is called from HULL to display the beam grid on each panel of a section to check the grid and to check for duplicate beams on GUNITE created BXXXX.GOM files.

SUBROUTINE MDPLOT called from HULL, plots plate and beam elements for locating boundary conditions with the terminal cursor. The nodes to be constrained are located by drawing a window around them. All the the nodes within the window are then given the same degrees of constraint as specified by terminal input.

SUBROUTINE HULOAD is called from HULL and assigns hydrostatic pressure loads by displaying the hull model on the terminal screen and identifying the loaded area with a window created by the use of the screen cursor. A graphic description of standard load cases can be displayed on the terminal screen for reference prior to assigning the loads. Balance-on-a-wave loading is an optional loading case which can be applied within SHPHUL.The pressure loads created in this manner are stored on file SHPHL.LOD in VAST data format.

SUBROUTINE FIGURE is called from HULOAD. It can display graphically, as a user option, the standard hull, deck and bulkhead loading cases.

SUBROUTINE PATMOD is called from MAIN to generate a PATRAN session file for display of the model by PATRAN graphics.

PROGRAM UNITE assembles the SXXXX.GOM files listed in SHPHL.DAT into substructures equivalencing matching panel nodes. The substructure geometry file generated by UNITE is SHSUB.GOM.

3.2 Program Files

The files generated by SHPHUL are organized to store model data at various stages of model creation. The end purpose is to produce data in the form of a series of assembled and loaded substructures which can be analysed by VAST. A series of VAST.GOM files of sections can also be generated for analysis as individual structures or, when assembled by the program VASGEN, as one geometry and connectivity file for the total structure.

3.2.1 Bodyplan Files

The bodyplan file, PREFX.DAT, can be created within SHPHUL by digitizing a plan, or by converting supplied tabular data to the proper format or by manually measuring the sections

and producing a formatted file of the data. The file in free format is structured as follows.

```
Record 1  Title
Record 2  Length Between Perpendiculars and Units Used  mm. in. etc.
Record 3  Station no.  Number of Offsets  Dummy no.
Record 4  X Offsets
Record 5  Y Offsets
Record 6  Station No.  Number of Offsets
Record 7  X Offsets
Record 8  Y Offsets
       |
       |
Record N
```

Record 3 can be read in a second format. Either format is handled by BODYPLAN without additional input from the user. In the second format the station number is replaced with a factor which when multiplied by the length between perpendiculars divided by 20 gives the Z coordinate of the station for which the X and Y coordinates are given. Thus a value of -1.021 would give a location forward of the forward perpendicular and a value of 20 would give the distance to the aft perpendicular. The NUMBER OF OFFSETS remains as in format 1 and DUMMY is replaced with the STATION NO.

```
Record 3  Factor  Number Offsets  Station no.
```

The data file can also contain additional data such as reference lines for locating decks and changes of plate thickness. The presence of this data is indicated by LOCATION REFERENCE LINES printed at the end of the coordinate data. An example of the two files is shown in Appendix A. Figure 3.1 shows the coordinate axis system. The datum is the forward perpendicular and the lowest point on the keel. Format 2 is the data form required by SHPHUL.

As described previously the body plan file PREFX.DAT can be regenerated with the subroutine BODYPLAN so that the body plan sections fall on frame locations. With this arrangement SHPHUL can generate the required number frames between them. The use of subroutine BODYPLAN creates the additional files PREFX.NDT, PREFX.WLN which are the new body plan and waterline files generated from PREFX.DAT. In the regeneration the PREFX.NDT is produced in the form of Format 2.

3.2.2 Beam Data File

The beam data file BEAMS.DAT is created by prompts within SHPHUL. An example of a file is shown in Appendix B. The sizes and properties of the beams used in the hull structure are

entered and stored in the file in response to the following prompts.

```
ENTER NUMBER OF BEAM SIZES USED IN MODEL
3
```

The number of beam sizes used in the model should be entered at this stage although the number can be increased later if required.

```
ENTER BEAM TYPE, SIZE AND MASS (eg. WT 305 X 72)
FOR BEAM 1
WF 84 X 14
```

The type of beam is described using conventional abreviated format. For metric beams mass in kilograms per metre and nominal depth in milimeters are used. For Imperial sizes the weight and nominal depth in inches can be used.

```
ENTER
0 = BEAM PROPERTIES SPECIFIED BY USER
1 = BEAM PROPERTIES CALCULATED FROM DIMENSIONS
```

The beam properties can be entered in detail if they are known or the beam dimensions can be entered and VAST will calculate the properties. In this case the option to enter the beam properties directly was chosen. An example of the entry of beam dimensions is given Chapter 9.

```
ENTER THE FOLLOWING PROPERTIES FOR THE BEAM
ENTER CROSSECTION AREA
24.71

ENTER THE TORSIONAL MOMENT OF INERTIA ABOUT
LOCAL X AXIS
1000
```

The local axis system is right handed with X along the length of the beam see Figure 3.2 and page C2-E3.8 VAST User's Manual.

```
ENTER MOMENTS OF INERTIA ABOUT LOCAL Y AND Z AXES
```

```
225.29  928.4

ENTER PRODUCT OF INERTIA
0
```

The product of inertia is 0 for symmetrical sections.

```
ENTER THE LOCAL Y Z COORDINATES OF THE SHEAR CENTRE
RELATIVE TO THE CENTROID OF THE SECTION
0  0
```

The coordinates are 0 for symmetrical sections.

```
ENTER THE SHEAR FORM FACTORS FOR BENDING ABOUT LOCAL
Y AND Z. ENTER ZEROS IF SHEAR DEFLECTION NOT EXPECTED
0 0
```

Shear deflection generally is only significant for short stubby beams.

```
ENTER THE Y COORDINATES FROM THE CENTROID FOR FOUR STRESS
PTS ON THE SECTION. DEFAULT VALUES ARE 1.0
7 7 -7 -7
```

These are local points on the beam crossection at which VAST will calculate stresses. The corner of the flanges and the intersection of the web with the plating are generally chosen.

```
ENTER THE FOUR Z COORDINATES FROM THE CENTROID
6 -6  .25  -.25

ENTER BEAM ECCENTRICITIES (THE LOCAL Y AND Z DISTANCES THE
CENTROID IS OFFSET FROM THE LINE THROUGH THE NODES)
Y OFFSET PLUS HALF THE THICKNESS (P C2-E3.9 VAST USER'S MANUAL)
7.125  0
```

The eccentricity in the Y direction is the distance from the centroid of the section to the half thickness of the hull plate. In the Z direction it is 0 if the centroid lies on the centerline of the section.

```
ENTER BEAM TYPE, SIZE AND MASS (eg. WT 305 X 70)
FOR BEAM 2.
```

From this point on the prompts are repeated until all the beams have been entered. On completion of the entry, the beam data is displayed sequentially for each beam for checking purposes. The beam sizes in abbreviated notation are listed.

```
BEAM SIZES
1  WF 84 X 16
2  WF 50 X 16
3  WF 50 X 18
TO EXAMINE BEAMS ENTER 0
TO EXAMINE A SPECIFIC BEAM ENTER BEAM NUMBER
TO ADD A BEAM ENTERB -1
TO CHANGE DATA TITLE -3
TO EXIT ENTER -4
-4
```

3.2.3 Basic Panel Coordinate File

FRAME.DXX contains the basic panel coordinates generated by terminal sessions using the body plan prior to gridding with elements. For example, FRAME.D03 contains the 4 or 12 noded panels for section 3, the coordinates for the panels, and the information regarding the the number of frames and beams and the types used to grid the panels. The data contained is identified in the files themselves. The first record is the section title as shown in an example of a typical file in Appendix C.

3.2.4 Basic Panel Data File

PANEL.DAT file contains the number of panels, material properties, number of beam sections, beam properties, stress points, number of frames, number of beams, plate thickness and a flag to indicate biasing of the grid, if present, for each panel of the section model. It is a temporary file which is overwritten by each new section of panels generated. An example of the file is shown in Appendix D.

3.2.5 Panel Grid Coordinate File

MODEL.DAT file contains the grid proportions for the panels followed by the nodal coordinates for each of the grid points. The data contained in the file is important for bulkhead creation, PATRAN session file generation, and as a data base for graphic displays of the model. An example of the file is shown in Appendix E.

3.2.6 VAST Geometry File

SHPHUL.GOM file is used for temporary data storage for plotting of a section. It is also used to store data in VAST geometry file format for a section as a single unsubstructured model. As a temporary storage file it contains the grid proportions and the grid nodal coordinates for each panel forming the section. As a VAST geometry file it contains the nodal coordinates and the connectivity of the plates and beams in the section panels.

3.2.7 File Of Panel Finite Element Geometry File Names

SHPHL.DAT file contains the names of the finite element geometry files SXXXX.GOM. The first record is the name assigned to the substructures to be generated and the tolerance for equivalencing adjacent substructure nodes. At present the name is SHSUB with tolerances of 50 mm. for metric and 2 ins. for imperial units. The tolerance is scaled in accordance with the distance between panel nodes. The second record is the title of the model. The third record is the number of geometry files. The remaining records are the file names.

3.2.8 Panel Finite Element Geometry File

SXXXX.GOM file contains the geometry and connectivity of the elements of the panel for the section specified. For example S0304.GOM contains this data for panel 4 in hull section 3. The file is basically a VAST.GOM file. The first record contains the section title and the file name. The second record contains the number of substructures. The third record contains the number of geometric nodes, the number of displacement nodes, and the number of element groups. The remainder of the file is coordinates, element properties and connectivities.

3.2.9 File Of Beam Element Geometry File Names

SHPBM.DAT file lists the file names of the files containing the file names of the panel finite element geometry BXXXX.GOM.

3.2.10 Panel Beam Finite Element Geometry File

BXXXX.GOM file contains essentially the same data as SXXXX.GOM except it is used by the subroutine BEAMCK for checking the beams gridded in a panel for such conditions as duplicate beams.

3.2.11 Superelement File

SHPHL.SED is the superelement file. It lists the number of levels of superelements, the number of superelements, the number of master nodes for the superelements, the number of slave nodes. It also lists the substructure displacement nodes used as master nodes and the master node number corresponding to substructure displacement node numbers and the master coordinates of the superelement X,Y,Z coordinate system. See the VAST user's manual for more information.

3.2.12 PATRAN Session File

SHIPM.SES is a session file which contains the model geometric data in the form of PATRAN grid point coordinates and patches. This data is followed by the node and element generation directives GFEG and CFEG.

3.2.13 Load And Boundary Condition Files

Load and boundary condition files SHPHUL.LOD and SHPHUL.SMD are created by SHPHUL in the format required by VAST. Reference should be made to the VAST user's manual for interpretation of the data. For the case of balance- on-a-wave loading the file PROFL.DAT, created by the program POSBOW[8], is required.

3.2.14 Added Fluid Mass Files

The added fluid mass of the water surrounding the immersed portion of the hull, after generation, is stored on PREFX.AMD.

3.2.15 Section VAST Geometry Files

SHPXX.GOM are VAST geometry files, one for each of the series created for later assembly by VASGEN [5] into a single unsubstructured model of the hull. XX is the section number of the model. For example SHP12 is section 12.

3.3 Program UNITE

A program called UNITE is used to merge the panel substructures. The substructure geometry files generated by SHPHUL, listed in SHPHL.DAT as SXXXX.GOM, are processed by UNITE which assembles them in the form of substructures. In the process all joining panel nodes are equivalenced and substructure connectivity node numbers are assigned. Master nodes for the superelements to be formed are generated. These nodes are listed on SHSUB.SED which is a VAST superelement file(ref pC3-3 VAST User's Manual). The corresponding substructure geometry file generated by UNITE is SHSUB.GOM. When UNITE is run it prompts for the file prefix listing the panel geometry. For SHPHUL this file prefix is SHPHL. Documentation detailing the preparation of files for running UNITE is stored on UNITE.DOC. A copy of the documentation is given in Appendix F.

3.4 Model Size Parameters

The size of the model that can be created by SHPHUL is controlled currently by six parameters which set the array sizes within the program. They are found in file SHPHUL.PAR which is listed in Appendix G. They are;

1. NSMAX=the number of body plan section lines.
2. NPMAX=the number of panels in one hull section including decks, hull side and longitudinal bulkheads.
3. NBMAX=the number of longitudinal beams in a panel.
4. NFMAX=the number of transverse frames in a panel.
5. NBPMAX=the number of body plan coordinates, NSMAX lines by M points where M=20. eg. 20 x 20 = 400
6. NBTMAX=number of beam types used to define all beams in the ship

The following parameters are derived from the other six.

1. NPPMAX=number of points defining the panels in one section. Each panel is defined by 4 or 12 points.
2. NPNMAX=number of nodes generated on a panel defined by the beam grid.
3. NODMAX=total number of nodes in a section.

The array size parameters can be changed when required by editing SHPHUL.PAR.

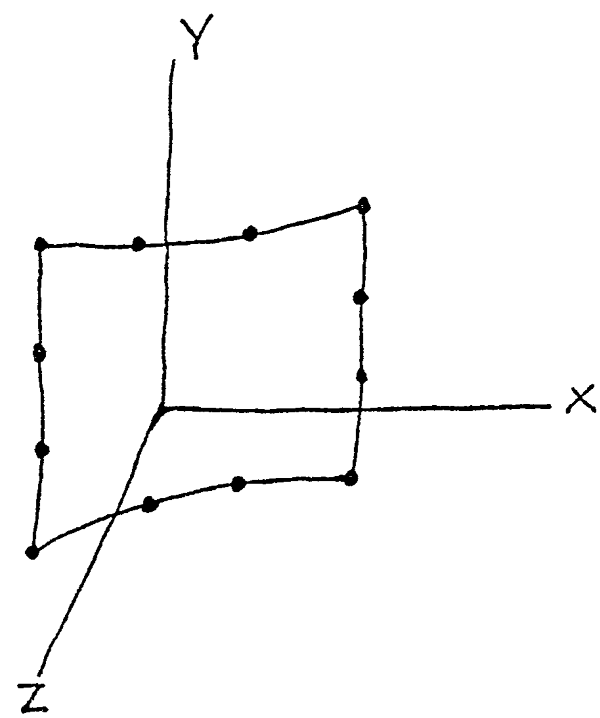


Figure 3.1: Coordinate Axis System For SHPHUL

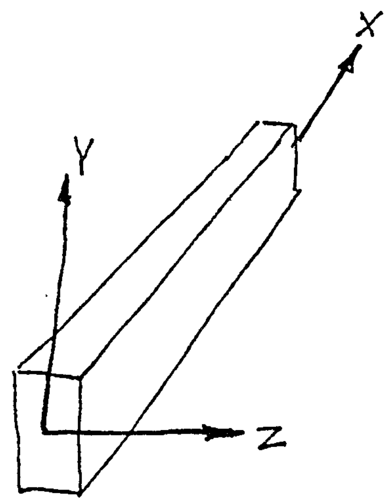


Figure 3.2: Beam Local Axis System

Chapter 4

Program Operation

To generate a finite element model of a ship with SHPHUL some preliminary planning is required. In addition to the body plan, data on the location of decks and bulkheads and data on the types and sizes of beams used throughout the ship are required. Changes in plating thickness and material must be identified and located. The frame and longitudinal beam spacing is required along with the location of openings in the decks.

4.1 Preparing The Coordinate Data

4.1.1 Digitizing The Body Plan

The body plan coordinates can be obtained by direct measurement of the drawing if digitizing equipment is not available. To digitize a body plan using the capability within SHPHUL a Tektronix digitizing tablet and terminal are required. An example of a digitizing session is shown in Appendix H.

4.1.2 Body Plan Data Format

The standard body plan format is shown in Appendix A as data Format 1. It is generally in the form of 20 to 21 stations of X and Y offsets at equal intervals. Sometimes additional offsets are required to cover features that do not fall on the equal intervals. In this case, which is Format 2, the equal offset stations are retained and stations are inserted and the station number becomes a multplier of the equal interval. The procedure is best shown by the following example and by refering to Format 2 in Appendix A.

```
Distance between perpendiculars = 1000
```

```
Interval between 21 stations = 1000/20 = 50
Multplier at station 1 = 0
Multiplier at distance from forward perpendicular of 525 = 10.5
```

The data for both formats requires a title for the first line. The second line in the case of Format 1 requires the hull length between perpendiculars and the units as (F10.2,1X,A). The third line requires the station number as the first record, the number of offsets for the station as the second record, and a dummy number for the third record. The succeeding lines are the offsets. The third line in the case of Format 2 has the multiplier as the first record and the station number as the third record. SHPHUL can process body plan data in either format.

4.1.3 Generating A New Body Plan

Once the basic body plan file PREFX.DAT has been obtained it is unlikely that it will correspond to the frame spacing. It will then be necessary to regenerate it to obtain this correspondence. The first step required is to divide the hull into a series of structural segments as shown in Figure 4.1. The segments are based on the locations of features such as compartments, bulkheads and changes in structural details,which are to be modelled by griding the panels with beams and plate elements . The boundaries of each of the segments must fall on a frame station to set up automatic frame and plate element generation. Each segment must be defined by four equally spaced bodyplan curves onto which the four or twelve noded panels will be superimposed. To meet these requirements the two bodyplan outer curves, corresponding to the segment fore and aft boundaries, must also fall on frame locations. It is unlikely that the supplied lines will do this and it will be necessary to generate the required lines from the given lines with the program BODYPLAN. To do this the distances from the forward perpendicular for each of the four lines for each of the segments must be determined. Distances forward of the forward perpendicular are negative. These distances are entered by responding to prompts from BODYPLAN and are stored on file PREFX.BDP. The new bodyplan file created is PREFX.NDT which must be renamed to PREFX.DAT to be used by SHPHUL. The new body plan file created is in the form of data format 2, as shown in Appendix A.

The following is a example terminal session of the use of BODYPLAN to create the required new curves.

```
RUN BODYPLAN

WHAT IS THE LINE SPEED?
9600
```

```
IDENTIFY TERMINAL TYPE ACCORDING TO RESOLUTION,
CURSOR AND COLOUR CAPABILITY:
ENTER 0 FOR TEKTRONIX 4006 (LOW RES/NO CURS/NO COL)
      1 FOR TEKTRONIX 4010/12/13 (LOW RES/CURSORS/NO COL)
      2 FOR TEKTRONIX 4014/4015  (HI RES/CURSORS/NO COL)
      3 FOR TEKTRONIX 41XX/42XX OR 4014/4015-EGM (COLOUR)
1

IDENTIFY TERMINAL TYPE ACCORDING TO DIALOG CAPABILITY:
ENTER 0 NO DIALOG AREA
      1 DIALOG AREA
0

ENTER BODY PLAN NAME
QUESM

SHIP NAME
 QUEST
```

The program displays the name of the ship written on the basic bodyplan file.

```
0 = CONTINUE AND GENERATE NEW PLAN
1 = CHANGE BODY PLAN NAME
2 = EDIT PREVIOUSLY GENERATED BODY PLAN
3 = STOP PROGRAM
4 = VIEW ORIGINAL BODY PLAN
0
```

The options presented allow and existing body plan to be changed as well as the original body plan to be viewed.

```
DISTANCE BETWEEN PERPENDICULARS    2820.00 in.
```

The distance is given as a check of the units and the basic dimension.

```
DATA MAY BE CONVERTED TO OTHER UNITS
ENTER CONVERSION FACTOR OR 1 TO RETAIN PRESENT UNITS
1
```

The units of the basic body plan file may be retained or changed to Imperial or SI units. In addition, feet can be changed to inches and meters to milimeters. If the units are changed then the distance between perpendiculars in the new units is displayed for confirmation.

```
ENTER 0 TO CONTINUE
      1 TO PLOT HULL OUTLINE
1
```

The outline of the hull may be plotted as shown Figure 4.2 to provide insight into quality and quantity of the data.

```
ENTER NUMBER OF NEW BODY PLAN CURVES TO COINCIDE WITH FRAME SPACING
55
```

The location of the required new body plan curves from the forward perpendicular is entered at this stage.

```
ENTER
0 = DATA IN NEW UNITS
1 = DATA IN ORIGINAL UNITS
1
```

The data may be entered in the original units or the new units if they have been changed. This saves time in preparing the data

```
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE  1
-143.9
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE  2
-120
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE  3
-96.00
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE  4
-72.00
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE  5
-48.00
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE  6
-24.00
```

```
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE  7
0.00
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE  8
48
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE  9
96
  |    |   |   |   |   |    |   |      |
  |    |   |   |   |   |    |   |      |
ENTER DISTANCE FROM FWD PERPENDICULAR FOR CURVE 55
2820


  1  -143.900
  2  -120.000
  3   -96.000
  4   -72.000
  5   -48.000
  6   -24.000
  7     0.000
  8    48.000
  9    96.000
 10   144.000
  |     |   |
  |     |   |
 55  2820.000

ARE DISTANCES CORRECT
IF YES ENTER 0 0
IF NO ENTER LINE NUMBER AND CORRECT VALUE
0 0
```

The data can be edited at this stage.

```
COMPUTING WATERLINES
```

Waterlines are produced for the generation of the new bodyplan curves.

```
ENTER 0 TO CONTINUE
      1 TO DISPLAY WATERLINES
```

```
1
```

The waterlines, as shown Figure 4.3, from which the new bodyplan curves will be generated can be displayed at this time as a check for data quality.

```
0 = CONTINUE AND DISPLAY ALL LINES
1 = DISPLAY INDIVIDUAL LINES
0
```

The waterlines may be displayed as single curves or all the curves can be displayed together.

```
TO CHECK FOR NEGATIVE SLOPES
YES=0  NO=1
0
```

A check of gross errors at the ends of the interpolated data can be made and corrected by linear interpolation.

```
NO REFERENCES FOR DECK LOCATIONS ETC.
ENTER
   0  TO CONTINUE
   1  TO ENTER REFERENCES
1
```

Reference lines such as deck positions and changes in plate thickness can be entered at this point as two character names. These lines, which will be plotted together with the body plan lines in the modeling stage, assist in planning the panel sizes.

```
ENTER THE NUMBER OF LINES
7

ENTER REFERENCE LINE NAME
LD

ENTER THE NUMBER OF POINTS DEFINING THE LINE
```

```
4
ENTER THE X,Y,Z COORDINATES OF POINT   1
0 180 0
ENTER THE X,Y,Z COORDINATES OF POINT   2
119.875 174.1 480.0
ENTER THE X,Y,Z COORDINATES OF POINT   3
191.25 170.6 768.0
ENTER THE X,Y,Z COORDINATES OF POINT   4
251.5 162.8 1416.0

ENTER REFERENCE LINE NAME
UD

ENTER THE NUMBER OF POINTS DEFINING THE LINE
12
ENTER THE X,Y,Z COORDINATES OF POINT   1
17.5 331.19 -72.0
ENTER THE X,Y,Z COORDINATES OF POINT   2
27.75 331.19 -48
ENTER THE X,Y,Z COORDINATES OF POINT   3
36.25 326.37 -24.0
ENTER THE X,Y,Z COORDINATES OF POINT   4
44.0 324.0 0.0
ENTER THE X,Y,Z COORDINATES OF POINT   5
  |    |   |   |   |   |    |   |      |
  |    |   |   |   |   |    |   |      |
  |    |   |   |   |   |    |   |      |
ENTER THE X,Y,Z COORDINATES OF POINT  12
251.62 252.19 1416.0
```

The data entry is continued as illustrated until the 7 lines have been entered.

```
LD
ENTER CORRECT NAME OR C TO CONTINUE
C
1     0.00    180.00       0.00
ENTER LINE NUMBER AND CORRECT DATA OR C TO CONTINUE
C
```

```
2   119.87    174.10     480.00
ENTER LINE NUMBER AND CORRECT DATA OR C TO CONTINUE
  |    |   |   |   |   |    |   |      |

UD
ENTER CORRECT NAME OR C TO CONTINUE
C
1    17.50    331.19     -72.00
ENTER LINE NUMBER AND CORRECT DATA OR C TO CONTINUE
C
  |    |   |   |   |   |    |   |      |
12  251.62    252.19    1416.00
```

Editing of the reference line data is possible with the title and then the coordinates displayed for each line.

```
REVIEW REFERENCE LINE DATA = 1
CONTINUE = 0
0
```

A final opportunity for review the reference line data is provided.

```
ENTER 0 TO CONTINUE
      1 TO PLOT AND EDIT NEW BODY PLAN
1
```

The new bodyplan can be plotted and edited at this stage. Figure 4.4. shows the new plan. Any undesirable kinks can be smoothed by identifying the line with the problem.

```
ENTER
0 TO CONTINUE
1 TO EDIT NEW BODY PLAN
1

ENTER THE NUMBER OF THE CURVE TO BE EDITED
```

```
S TO END
8
```

tt The entry of the curve number results in the numbered curve being plotted together with the curves on either side of it for reference, as shown in Figure 4.5. The curve can be modified by entering the required node number at which stage the cursor appears. The node can then be moved to a new location and the curve replotted for inspection as illustrated in Figure 4.6. In this manner the new body plan can be improved as required by selecting additional curves until S is entered to end the editing.

```
ENTER THE NUMBER OF THE CURVE TO BE EDITED
S TO END
S

0 TO CONTINUE
1 TO REPLOT BODY PLAN
0

DO YOU WISH TO PLOT ORIGINAL BODY PLAN 1 = YES 0 = NO 1
1
```

The original body plan can be plotted for comparison with the new curves as shown in Figure 4.7.

```
ORIGINAL BODY PLAN DATA QUESM.DAT
NEW BODY PLAN DATA QUESM.NDT
WATERLINE DATA QUESM.WLN
NEW BODY PLAN CURVE LOCATIONS QUESM.BDP
```

The data files produced are listed for printing if desired. The QUESM.NDT file must be renamed, for use with SHPHUL, to a new five character name, PREFX.DAT, to avoid confusion with the original QUESM.DAT file.

4.1.4 Beam Data

The beam data for the ship must exist in the beam data file before the model generation is begun. If a beam data file exists the program will display the name of the ship to which it applies. If the ship name is not the correct then the data does not apply unless it is of the same class as the ship to be modelled, in which case the name can be altered. The following program prompts will be displayed.

```
SHIP NAME FOR BEAM DATA
265 CLASS DDH


0 = CONTINUE
1 = CHANGE NAME
0

A COMPLETE DATA FILE EXSISTS
ENTER C TO CONTINUE AND USE THE DATA
      E TO EXAMINE AND EDIT THE DATA
C

ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQENCE FROM THE BOW
TO A MAXIMUM OF 20. THEY MAY BE ENTERED IN ANY ORDER
 ** ENTER S TO STOP **
4

A BEAM DATA FILE EXISTS CHOOSE FROM FOLLOWING
1 = USE EXISTING BEAM DATA
2 = CREATE A NEW BEAM DATA FILE
3 = EXAMINE OR EDIT EXISTING FILE
1
```

The file can be examined for the ship name and beam sizes. It can be edited at this time if beam sizes must be changed. If a suitable beam file does not exist then one can be created within SHPHUL by following the procedure of responding to the SHPHUL prompts as illustrated in section 3.2.2 of Chapter 3.

4.2 Options For Generating A Model

SHPHUL is an interactive program. See Appendix I for loading instructions. On loading to create a hull finite element model the following initial prompts appear on the terminal screen.

```
RUN SHPHUL
WHAT IS THE TERMINAL LINE SPEED
9600
```

The baud rate of the communication link with the terminal is requested.

```
IDENTIFY TERMINAL TYPE ACCORDING TO RESOLUTION,
CURSOR AND COLOUR CAPABILITY:
ENTER 0 FOR TEKTRONIX 4006 (LOW RES/NO CURS/NO COL)
      1 FOR TEKTRONIX 4010/12/13 (LOW RES/CURSORS/NO COL)
      2 FOR TEKTRONIX 4014/4015  (HI RES/CURSORS/NO COL)
      3 FOR TEKTRONIX 41XX/42XX OR 4014/4015-EGM (COLOUR)
2
```

The program has been designed to run on Tektronix terminals or terminals with Tektronix emulation packages. In this case a 4014 terminal is assumed.

```
IDENTIFY TERMINAL TYPE ACCORDING TO DIALOG CAPABILITY:
ENTER 0 NO DIALOG AREA
      1 DIALOG AREA
0
```

The terminal chosen does not have the ability to place the dialog between terminal and user at the bottom of the screen.

```
WHAT DIGITIZING TABLET IS TO BE USED ?
TYPE 3 FOR 4953, 4 FOR 4954, 6 FOR 4956,  8 FOR 4958
0
```

This prompt will appear if the tablet capability is switched on. It allows for the use of a Tektronix digitizing tablet for generating coordinates from a bodyplan drawing. In this case the coordinates are available and a zero entry indicates that digitizing is not required.

```
THIS PROGRAM GENERATES 3 DIMENSIONAL SHIP STRUCTURE IN THE
FORM OF ASSEMBLED GRILLAGE PANELS BETWEEN SELECTED END FRAMES
** ENTER DATA STARTING NEAREST THE HULL CENTERLINE AT THE MOST
FWD PANEL EDGE IN A COUNTER CLOCKWISE DIRECTION

ENTER A FIVE CHARACTER NAME FOR BODY PLAN OFFSET FILE
QUESM

 The bodyplan offsets are found on file QUESM.DAT.

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION,BEAM NORMALS,CHECK FOR DUPLICATE BEAMS,
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = GENERATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED HULL SECTIONS
15 = PLOT VAST GEOMETRY FILE
16 = STOP
```

The menu presents the options available for generating, viewing and editing the model as well as for mirror imaging and VAST analysis file generation. There are basically three types of models that can be created from these options. One is option 2 by which a single section model and its VAST files are generated including the PREFX.GOM file composed of the nodal coordinates and the element conectivities, the PREFX.SMD file of boundary conditions, and the PREFX.LOD of pressure loads.

The second model type is option 11, a substructured model, in which every panel of the section is a substructure. The panels nodes are equivilenced within the sections. A series of sections forming as much of the hull as desired can be generated. The the individual section

substructured files are formed as SXXXX.GOM files by the subroutine GUNITE. The list of file names of these substructures is stored on SHPHL.DAT. The substructures are joined and a master node file is created by the program UNITE which uses the SHPHUL.DAT file to identify the substructures to be joined.

The third type of model is option 12 which creates a series of VAST geometry and element files, one for each section specified, as SHPXX.GOM files. The XX is the section number. These SHPXX files can then be assembled into a single structure geometry file, named by the user, with the program VASGEN[5]. A single model of the entire hull can be formed in this way. It will of course have a large number of degrees of freedom and will require a large and fast computer to analyse it.

Each of the 15 options in the option list will be described in detail in the following chapters.

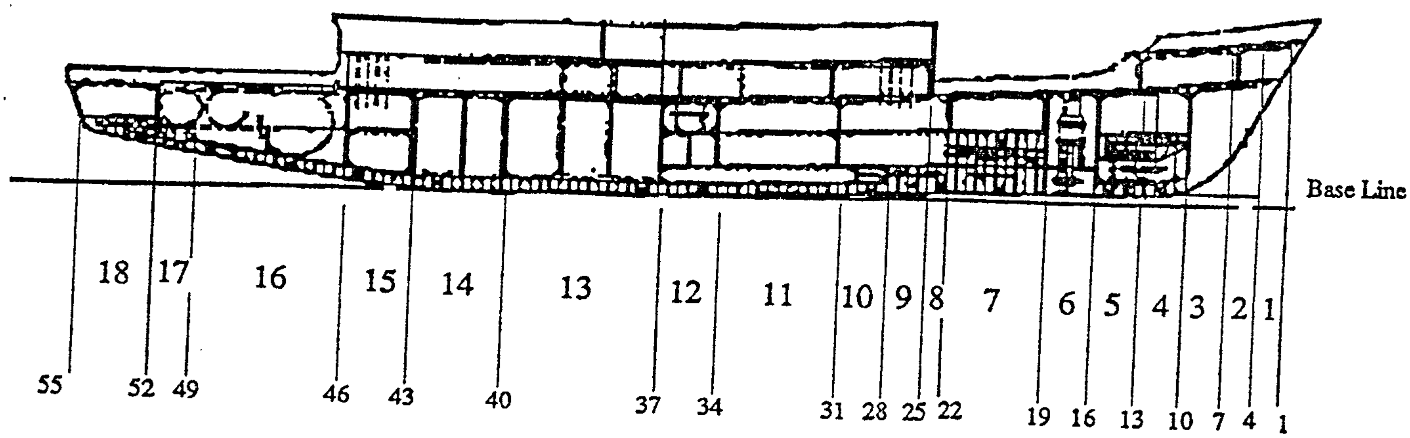


Figure 4.1: Location Of Hull Segments And New Bodyplan Curves

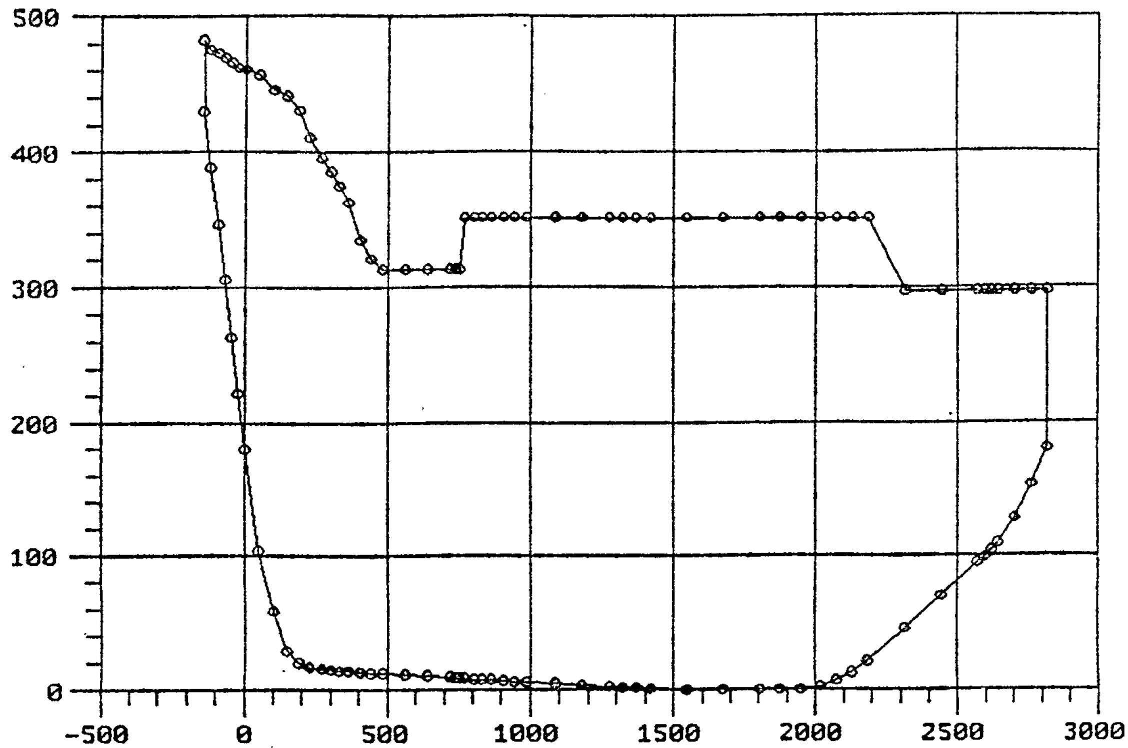


Figure 4.2: Hull Data Outline

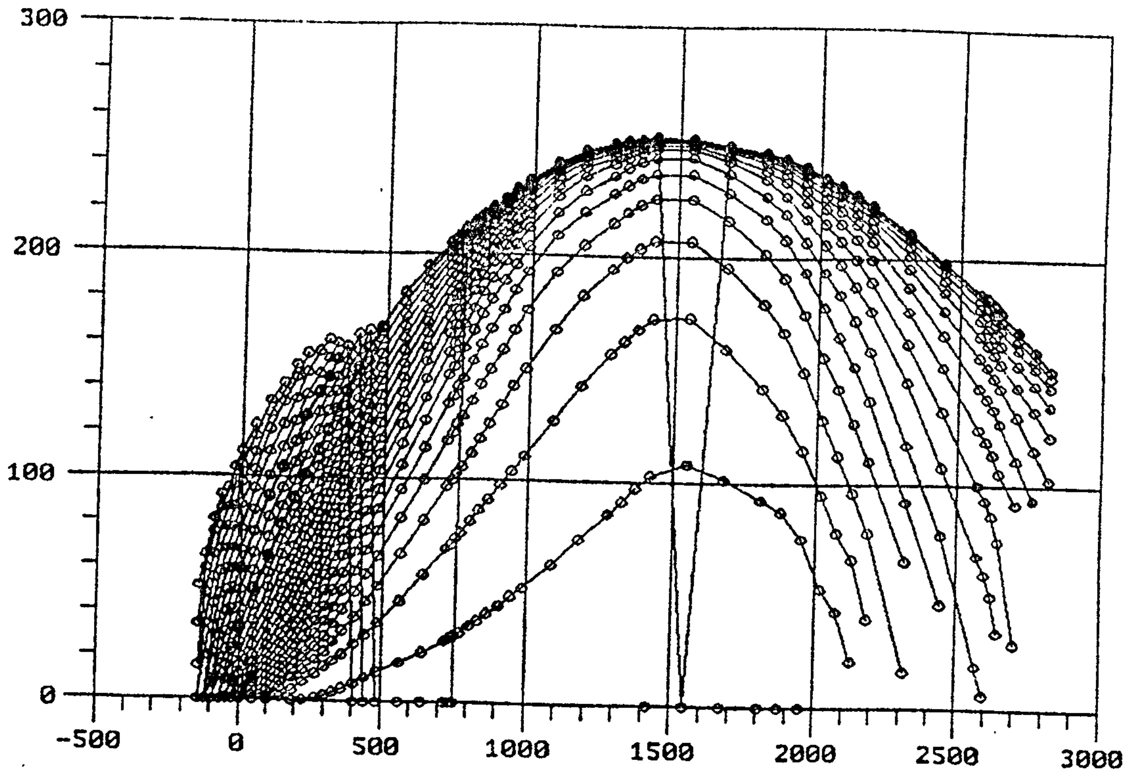


Figure 4.3: Waterlines Generated From Original Bodyplan Data

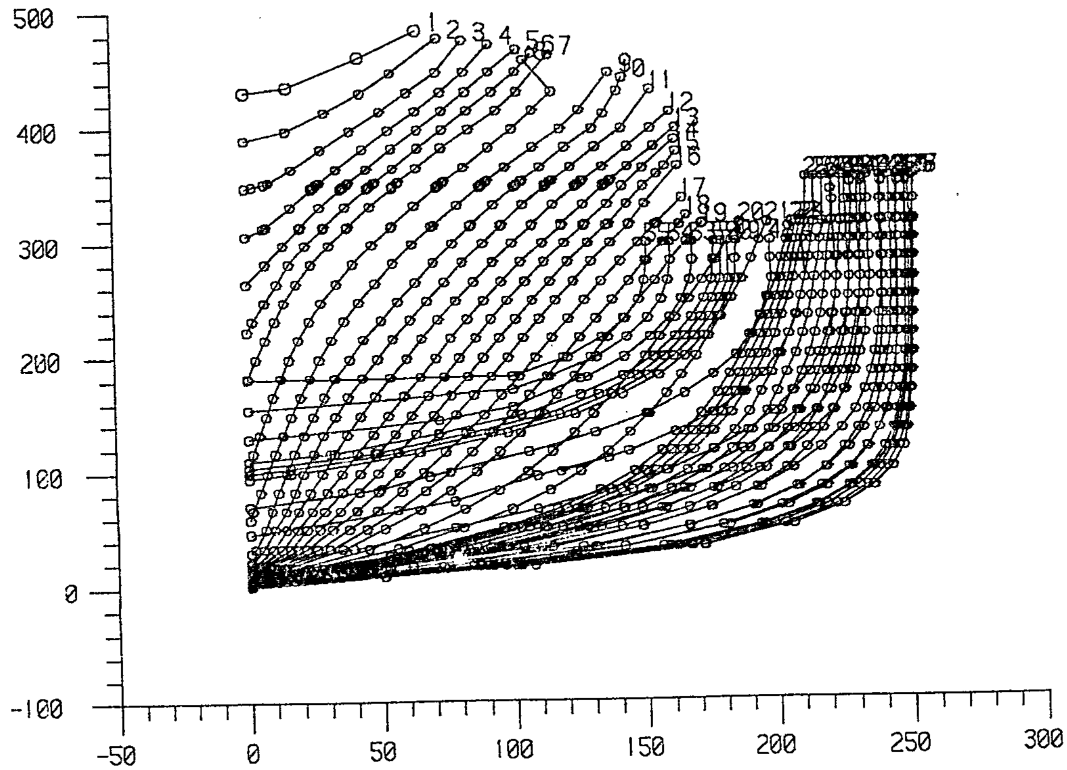


Figure 4.4: New Bodyplan Curves

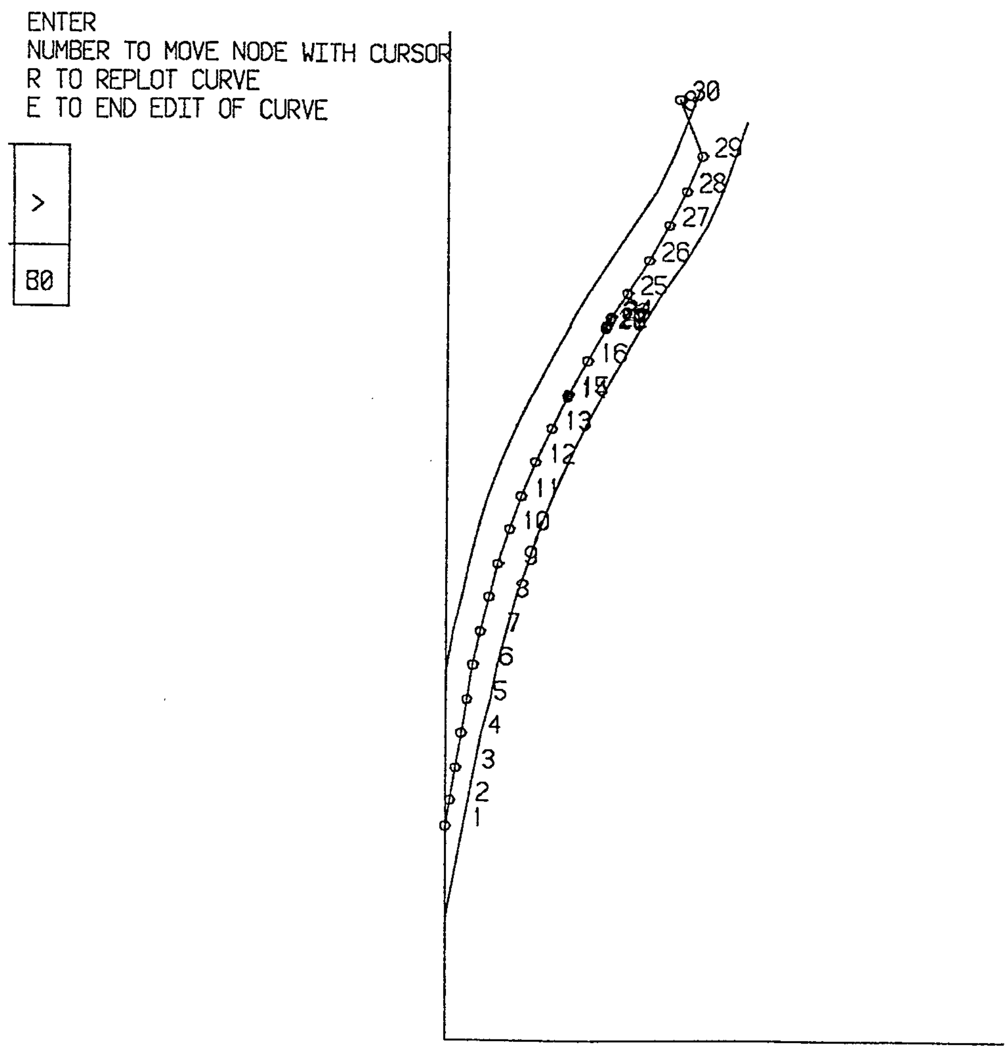


Figure 4.5: The Curve To Be Edited Plotted With Two Adjacent Curves

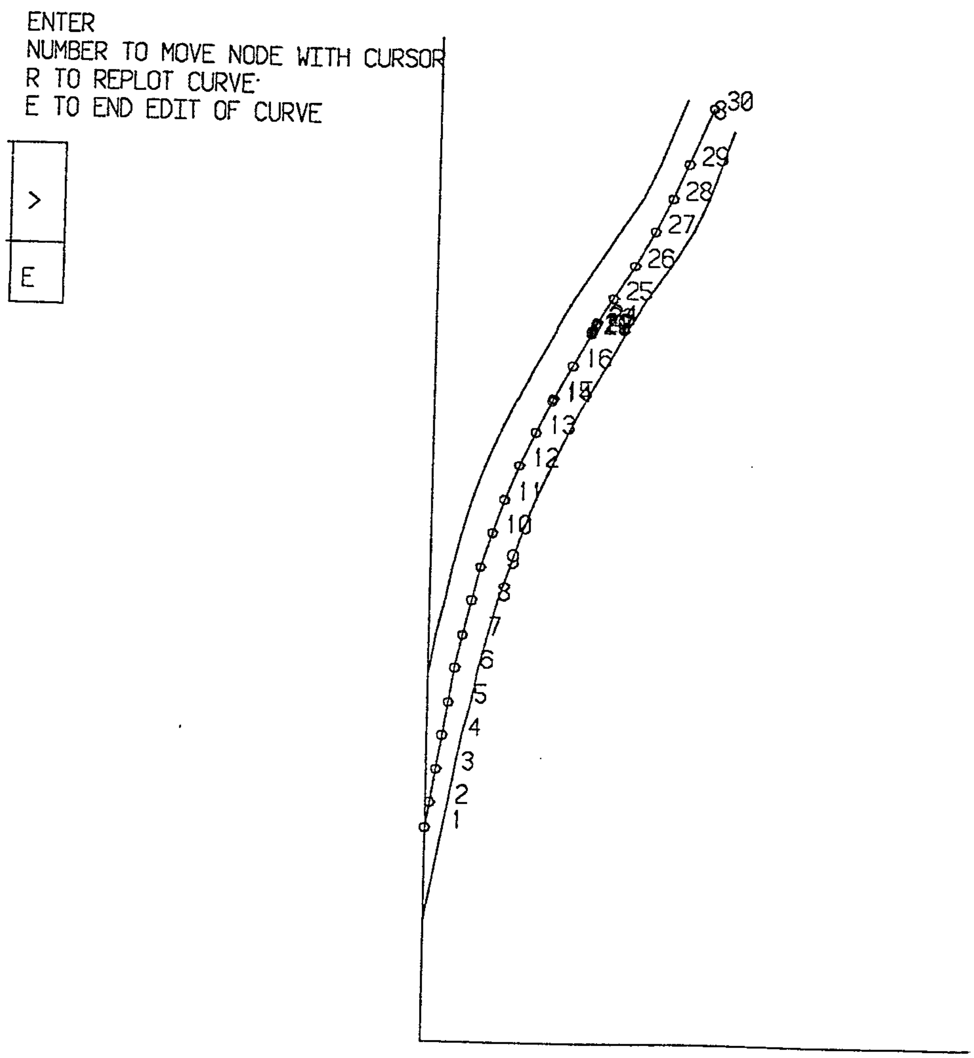


Figure 4.6: The Corrected Curve Replotted For Inspection

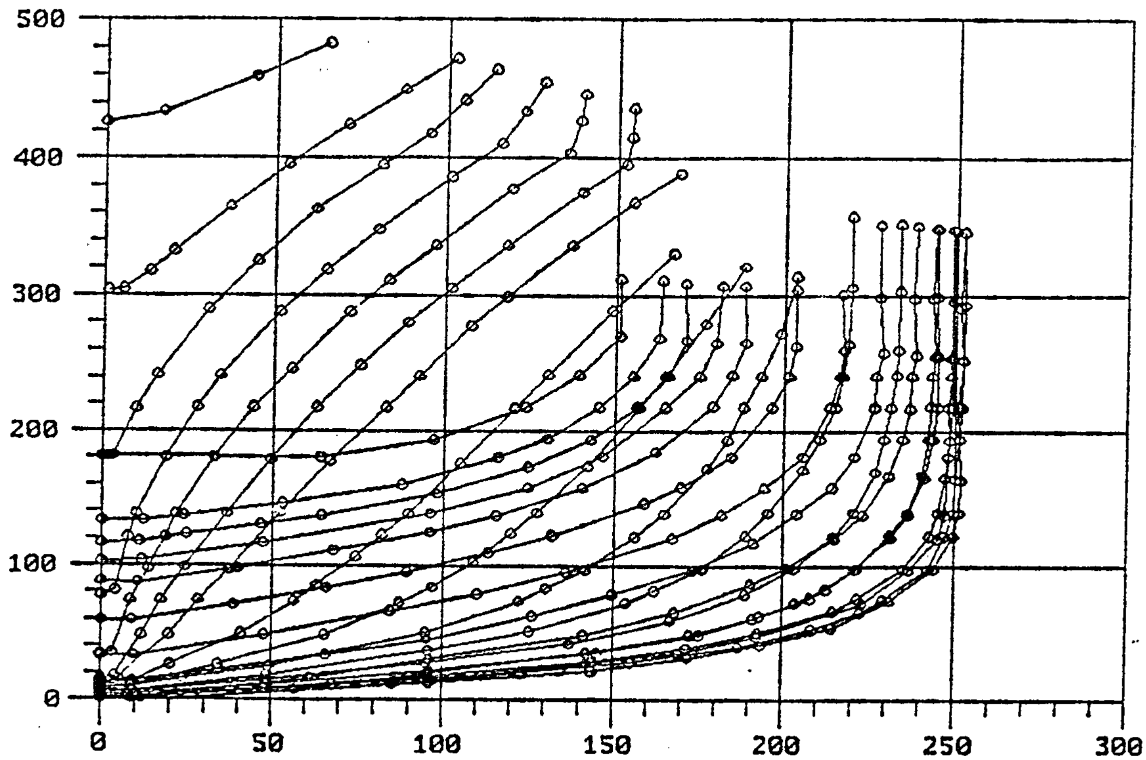


Figure 4.7: Original Bodyplan

Chapter 5

Option 1 New Section

At this stage the required new bodyplan has been generated and a beam file of beam sizes and properties has been produced. The option to create a new section, composed of panels gridded with beam and plate elements, produces the following prompts.

```
SHIP NAME FOR BEAM DATA
QUEST
0 = CONTINUE
1 = CHANGE NAME
1
```

If the beam file can be used on more than one ship type then the ship name can be changed to that of the ship being modelled.

```
ENTER SHIP NAME AND DATE
QUEST 12/10/91

A COMPLETE DATA FILE EXISTS
ENTER C TO CONTINUE AND USE THE DATA
      E TO EXAMINE AND EDIT THE DATA
C
```

A complete bodyplan data file exists which can be viewed and edited if required.

```
NO REFERENCE DATA FOUND
```

```
D TO DEFINE DATA
     STOP PROGRAM
```

This prompt will appear rather than the previous one if there are no reference lines locating decks, ecetera, included in the body plan file. This prompt will also appear if there are problems in the body plan data. The process can be continued and the body plan lines data used without the reference lines or the reference data can be defined at this stage.

```
ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 90. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
2
```

The sections are best numbered sequentially from the bow as this improves the efficiency of the equivalencing when the sections are assembled with one another. It is also necessary for generating substructures later in the modelling process.

```
A BEAM DATA FILE EXISTS CHOOSE FROM FOLLOWING
1 = USE EXISTING BEAM DATA
2 = CREATE A NEW BEAM DATA FILE
3 = EXAMINE OR EDIT EXISTING FILE
1
```

This allows the existing beam data file to viewed and edited if necessary with the option to produce an entirely new file.

```
ENTER THE AXIS ALONG WHICH THE LENGTH OF THE HULL IS MEASURED
Z
```

Z has been chosen for the longitudinal axis of the ship which puts the bodyplan data in the XY plane. X can also be used as the longitudinal axis if desired.

```
CHOOSE FROM MODELLING OPTIONS
1 = STRAIGHT SIDED PANELS BETWEEN END FRAMES
2 = CURVILINEAR PANELS BETWEEN END FRAMES
```

2

The curvilinear panels produce a more accurate model but require a factor of three more data.

READ FILE FRAME.D01

The program reads the previous section data for referencing and displaying connecting panel nodes to ensure reasonable fore and aft connectivity.

BODY PLAN FILE= QUESB
BODY PLAN TITLE= CNAV QUEST
ENTER C TO CONTINUE

This confirms that the correct bodyplan data is being used.

ENTER THE STATION NUMBERS OF THE FIRST AND LAST SECTIONS OF
THE BODY PLAN TO BE PLOTTED
ENTER NEGATIVE VALUES FOR A DISTORTED PLOT
ENTER S TO STOP
1 55

The complete range of 55 bodyplan curves can be examined at this stage as shown in Figure 5.1. After viewing and clearing the screen a carriage return will repeat the prompt for the bodyplan curves to be used for creating the new section. It is best to plot four curves for the 12 noded panel to account for the curvature of the hull. Only two curves are needed when the four noded panels are used. Negative values increase the scale of the body plan plot on the X axis which is especially necessary in the midship region where the body plan curves are very close to one another.

ENTER THE STATION NUMBERS OF THE FIRST AND LAST SECTIONS OF
THE BODY PLAN TO BE PLOTTED
ENTER NEGATIVE VALUES FOR A DISTORTED PLOT
ENTER S TO STOP
-7 -10

The distorted plot option has been chosen because of the close proximity of the body plan lines.

```
WITH THE DISTORTED PLOT DECKS MUST BE ADDED SEPARATELY USING OPTION 4
ENTER 0 TO CONTINUE
```

Figure 5.2 shows the 4 curves with the plotting expanded in the X axis direction. The crosses displayed are the panel points of the previous section. The new panel points to be entered must be aligned with these to guarantee panel connectivity along the length of the model.

The entry of an R at this stage will result in the plotting of reference lines identifying boundaries of decks and special hull features such as hull strengthing ice belts as shown in Figure 5.3.

The entry of an M will display the graphics cursor for defining the panels. The cursor defined panel points are defined by moving the cursor to the the desired point and pressing the mouse button or the character P on the key board. These cursor defined points appear as smaller crosses. The points should be entered counter clockwise for side panels to place the beams on the inside of the model. The first 4 points entered should follow down the most forward bodyplan curve. They will automatically be given a constant Z value if Z has been chosen as the length axis of the ship. The next 3 points will be given new Z values automatically incremented by an amount equal to the 4 bodyplan curves spacing. They should therefore fall on succeeding bodyplan lines. The next 3 points should follow up the most aft body plan curve as they will be given equal Z values. The final 2 points of the 12 noded panel should be placed on the mid bodyplan curves to finally complete the four sided panel. Points that fall on the Y axis which have zero X values will not likely have this value assigned to them because of cursor location inaccuracies. It is best to place the cursor slightly to the negative X side of the Y axis. The program will automatically convert these negative X values to zero thus ensuring zeros along the keel line and the deck center line.

In the case of decks the rotation is clockwise although in reality it is counter clockwise when viewed from the inside looking outwards. The first 4 points should be equally spaced from the hull centerline until the 4th point meets the most forward bodyplan curve. The next 3 points are placed on the succeeding curves and then 3 points are placed equally spaced towards the centerline to the deck edge. The final 2 points are placed vertically at the spacing of those falling on the mid bodyplan curves. If the deck should be flat then the last 3 points will be identical in X and Y but different in Z. Points applied in this rotation will place the beams under the deck. If they are applied starting at the most forward bodyplan curve, in sequence towards the centerline, then the beams will be placed on top of the

deck. Figure 5.4 shows the sequence of panel numbering to place the beams on the inside of the panels and under the decks.

The completion of the location of the 12 nodes will be indicated by a beep from the terminal. To continue with additional panels enter a carriage return. This will cause the cursor crosshairs to return and the procedure can be continued. To stop enter S twice this stops the panel generation and results in the following statement identifying the hull being modelled.

```
SHIP NAME CNAV QUEST
```

A carriage return results in the following prompt.

```
IDENTIFY HULL PARTS
1 = YES
0 = NO
1
TO IDENTIFY HULL PARTS ENTER AFTER EACH PANEL DISPLAY
S = SIDE
D = DECK
B = BULK
L = LONGITUDINAL BULKHD
T = STERN OR BOW BULKHD
ENTER C TO CONTINUE
C
```

The panels will be displayed sequentially as shown in Figure 5.5. Each is to be identified by entering the appropriate code. On completion of the identification a carriage return will trigger the following prompt to appear on the screen with the panels.

```
ENTER
NODE NUMBER TO CHANGE LOCATION WITH CURSOR
      W TO WINDOW PANEL
      R REPLOT PANELS
      E END EDIT OPTION
W
```

This provides the first opportunity to edit the data. Often the ajoining panel nodes are not directly superimposed on one another. This can be corrected by windowing the region where there is an indication that there may be a problem as shown in

Figure 5.6. The carriage return key must be hit until the windowed portion of the panel assembly appears and the prompt is repeated. The nodal points can then be brought into closer proximity by entering the number of the node to be relocated followed by a carriage return. The cursor crosshairs will appear and by positioning them in the desired location and entering P the point will be relocated. The procedure can be repeated as required and the results reviewed by entering R which will replot the assembly which again can be windowed for closer inspection. The entry of E will end the editing at this time and results in the following prompt.

```
 2 PANELS IN SECTION= 2

 PANEL GRIDING
1 = DECKS AND HULL SHELL
2 = LONGITUINAL BULKHEADS
3 = TRANVERSE BULKHEADS
4 = STERN OR BOW BULKHEAD
5 = STOP
1
```

The griding of the panels with plate and beam elements is begun at this stage with the request for identification of the components. There are number of gridding options for the panels depending on whether they are decks, sides or bulkheads. These are flagged by mopt in the program and can be found for each panel in the FRAME.DXX files. The griddings are illustrated in Figure 5.7.

```
ENTER TITLE OF SECTION TO BE MODELLED (MAX 50 CHAR)
BOW3
```

The title of the section is requested for future identification of the section files. The title can have up to 72 characters.

```
ENTER THE NUMBER OF TRANVERSE FRAMES IN PANEL  1  SIDE
5
```

The number of transverse frames in the section is requested. This is a constant for all side panels of the section. The size of the frames, however,can be different for each of the side panels.

```
ENTER THE NUMBER OF ELEMENTS BETWEEN FRAMES
```

The number of elements between frames is requested at this stage. To obtain reasonable plate and beam stresses at least 4 elements should be requested. It should be noted, that if a large model is to be created, it may be more economical to select one element and use a top-down procedure to obtain the more detailed plate stresses.

```
ARE FRAMES EVENLY SPACED
 0 = YES   1 = NO
0
```

It is possible to have unevenly spaced frames in the section panels.

```
*** PANEL    1 ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL   1   SIDE
ENTER S TO STOP DATA ENTRY
1
```

There can only be two sizes of beams in a panel. One size for the frames and one size for the fore and aft beams if they are present. The program will refuse a number greater than 2. A display of beams available in the beam data file is presented.

```
CHOOSE SIZE FOR PANEL   1 BY ENTERING LINE NUMBER
  1    6X1PL
  2    6X3.5A
  3    4X.5PL
  4    6X3.5X.3
  5    4X3A
  6    12X6T
2
```

```
** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL   1   SIDE
0
```

In this case there are no longitudinal beams used in the panels. The program asks for the number of transverse or vertical plates. They are vertical on the sides and transverse on the deck.

```
ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  1  SIDE
4

ARE PLATES EVENLY SPACED
 0 = YES    1 = NO
0

The plates can be unevenly spaced if necessary.

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
30000000

ENTER POISSONS RATIO
.3

ENTER DENSITY
.000734

ENTER THE PLATE THICKNESS FOR PANEL  1  SIDE
.3125

***  PANEL   2 ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  2  DECK
ENTER S TO STOP DATA ENTRY
1

 The next panel is to be gridded.

CHOOSE SIZE FOR PANEL   2 SIZE BY ENTERING LINE NUMBER
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
2
** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  2  DECK
0
```

```
ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  2  DECK
4
ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  2  DECK
.29

*** GRID NEXT PANEL ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  3  SIDE
ENTER S TO STOP DATA ENTRY
1

CHOOSE FRAME  3 SIZE FROM FOLLOWING BY ENTERING LINE NUMBER
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
2

** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  3  SIDE
0

ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  3  SIDE
4

ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
```

```
S

ENTER THE PLATE THICKNESS FOR PANEL  3  SIDE
.5

*** PANEL  4 ***
ENTER THE NUMBER OF DIFFERENT BEAM SIZES IN PANEL  4  DECK
ENTER S TO STOP DATA ENTRY
1

CHOOSE SIZE FOR PANEL  4 BY ENTERING LINE NUMBER
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
2

** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  4  DECK
0

ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  4  DECK
4

ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  4  DECK
.29

***  PANEL 5 ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  5  SIDE
ENTER S TO STOP DATA ENTRY
```

```
1

CHOOSE FRAME  5 SIZE FROM FOLLOWING BY ENTERING LINE NUMBER
  1    6X1PL
  2    6X3.5A
  3    4X.5PL
  4    6X3.5X.3
  5    4X3A
  6    12X6T
2

** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  5  SIDE
0

ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  5  SIDE
4

ARE PLATES EVENLY SPACED
 0 = YES    1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  5  SIDE
.5

*** PANEL 6 ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  6  SIDE
ENTER S TO STOP DATA ENTRY
1

CHOOSE FRAME  6 SIZE FROM FOLLOWING BY ENTERING LINE NUMBER
  1    6X1PL
  2    6X3.5A
  3    4X.5PL
  4    6X3.5X.3
  5    4X3A
```

```
  6   12X6T
2
** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  6  SIDE
0

ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  6  SIDE
4

ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  6  SIDE
.5

*** PANEL  7 ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  7  SIDE
ENTER S TO STOP DATA ENTRY
1

CHOOSE FRAME  7 SIZE FROM FOLLOWING BY ENTERING LINE NUMBER
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
2

** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  7  SIDE
0

ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  7  SIDE
4
```

```
ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  7  SIDE
.5
*** PANEL 8 ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  8  SIDE
ENTER S TO STOP DATA ENTRY
1

CHOOSE FRAME  8 SIZE FROM FOLLOWING BY ENTERING LINE NUMBER
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
2

** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  8  SIDE
0

ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  8  SIDE
4

ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  8  SIDE
```

```
.5

WRITING FILE FRAME.D02
```

The FRAME.DXX file is written storing the panel coordinates and the gridding information.

```
PROCESSING SECTION 2
```

The process of gridding the section for inspection is carried out using the shape functions described in Chapter 2.

```
PLOT SECTION MODEL 2
 0 = YES
 1 = NO
0
```

The ability to inspect the gridded model is provided at this point.

```
CHOOSE THE PLANE IN WHICH DECKS ARE TO BE DISPLAYED
1 =  LENGTH OF SHIP ALONG X AXIS
2 =  LENGTH OF SHIP ALONG Z AXIS
2

ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10

0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
1

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The assembled gridded panels are displayed at rotations of 5 degrees about the XYZ axes as shown in Figure 5.8. A carriage return displays the following menu for further inspection of the model.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
4
```

The display of the panel normals indicates on which side of the panel the beams will be attached. If they are not on the correct side the model panel will have to be regenerated with the 12 panel nodes entered in the reverse rotation.

```
ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The panel normal plot is shown in Figure 5.9. A carriage returns the menu.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
6
```

The beam grid has duplicate beams automatically removed at adjoining panels as a first approximation. The beams are displayed a panel at a time for visual inspection. If the beam arrangement is not entirely satisfactory boundary beams may be added or subtracted as required in the editing option found in the main menu. The beams are displayed in Figure 5.10.

```
GENERATING SHPHL.DAT AND GEOMETRY FILES
FOR HULL SECTION 2
```

```
1 = INCREMENTLY PLOT PANELS
1

 After the display of the plot a carriage return will return the menu.

2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
8

FILE NAME PREFIXES STORED ON SHPHL.DAT AND SUBSTRUCTURE GEOMETRY
FILES ON SXXXX.GOM

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
 2 = GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = STOP
15
```

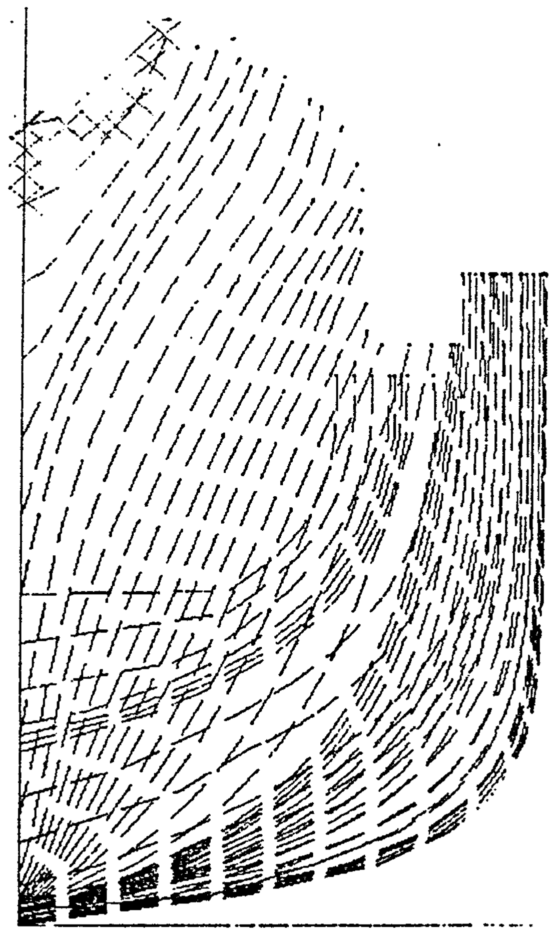


Figure 5.1: Complete Bodyplan For QUEST

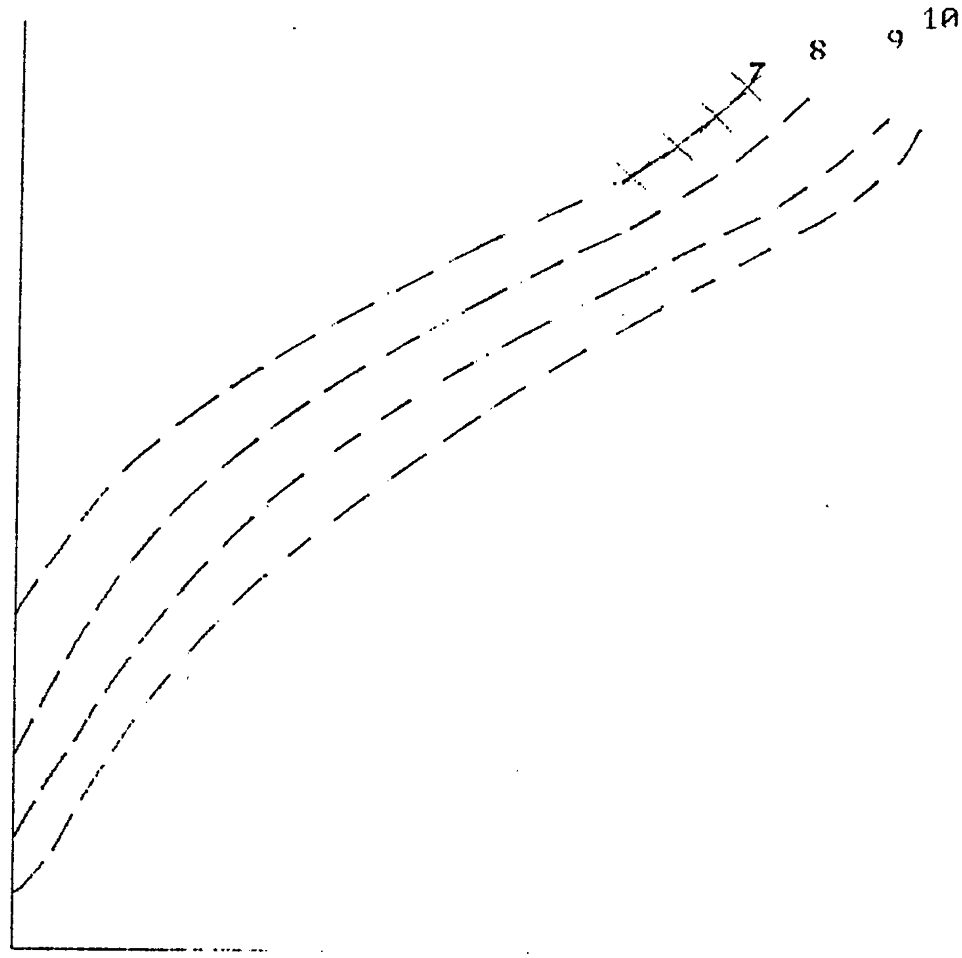


Figure 5.2: Four Expanded Bodyplan Curves For Panel Generation Of Section 2

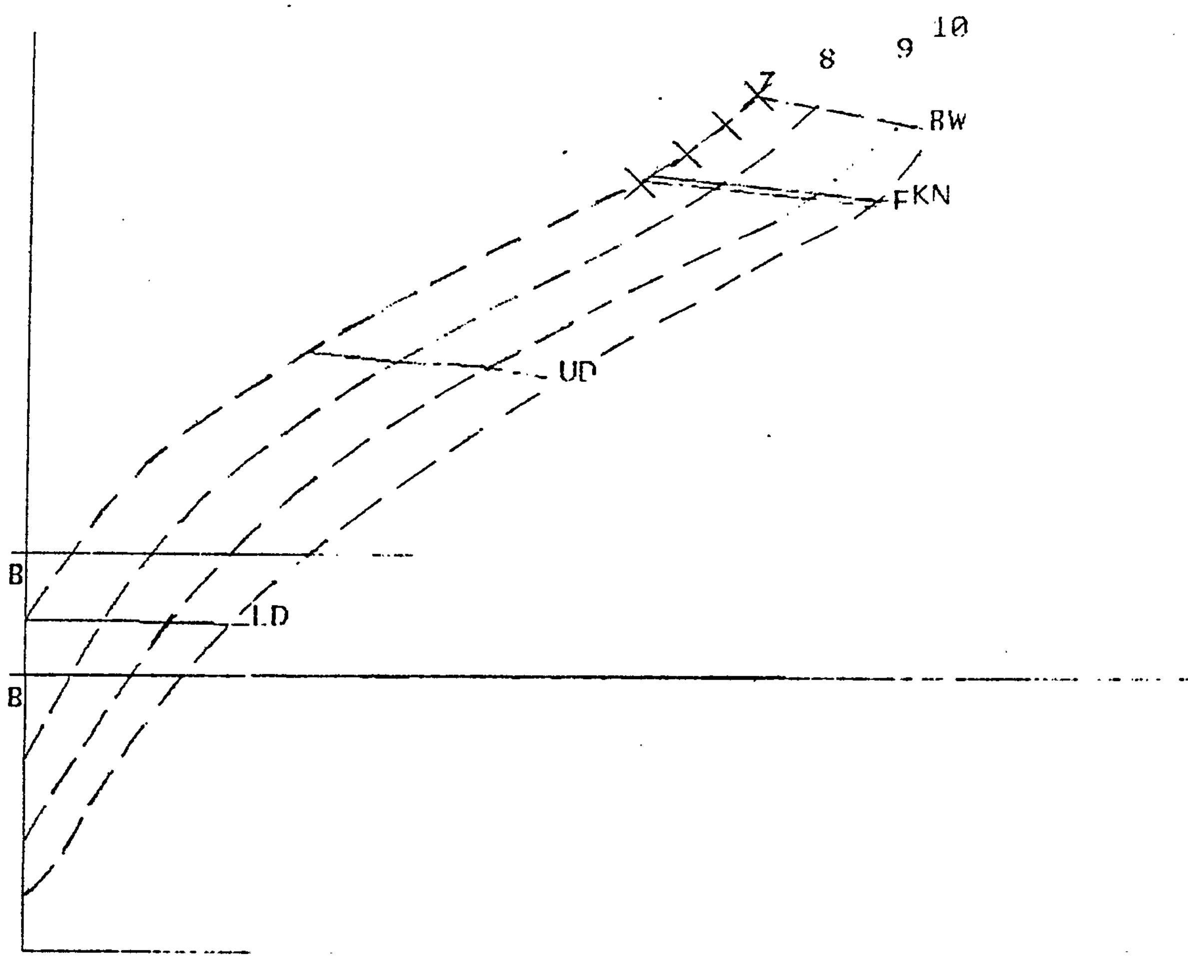


Figure 5.3: Bodyplan Curves With Reference Lines For Decks Etc.

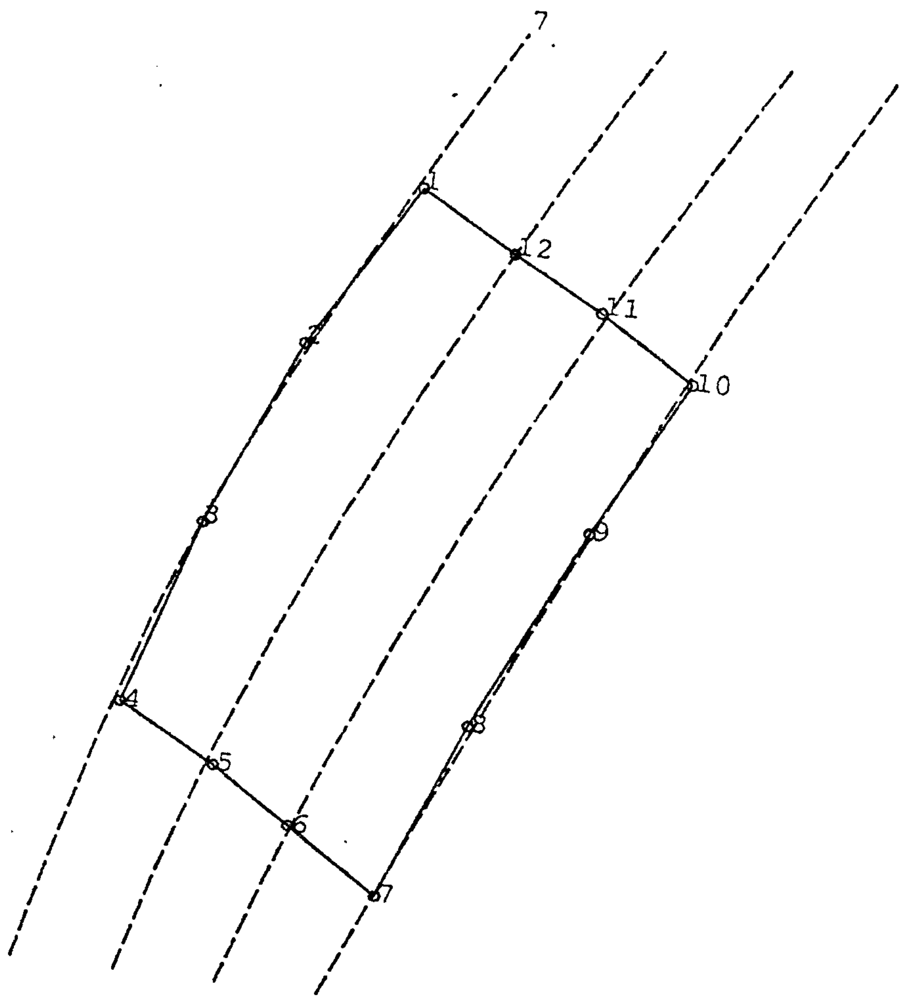


Figure 5.4: Sequence Of Panel Node Numbering To Place Beams On Inside Of Hull

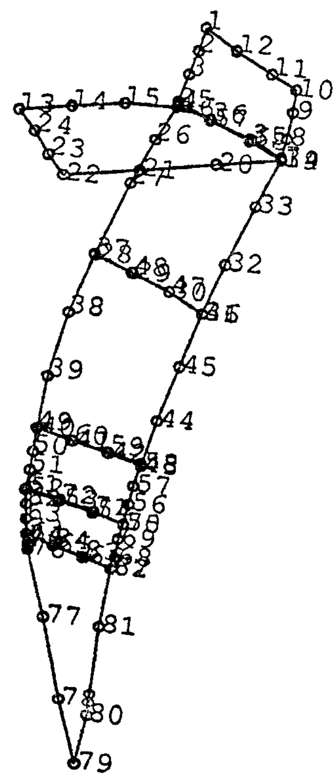


Figure 5.5: Display Of Panels For Identification Of Sides and Decks

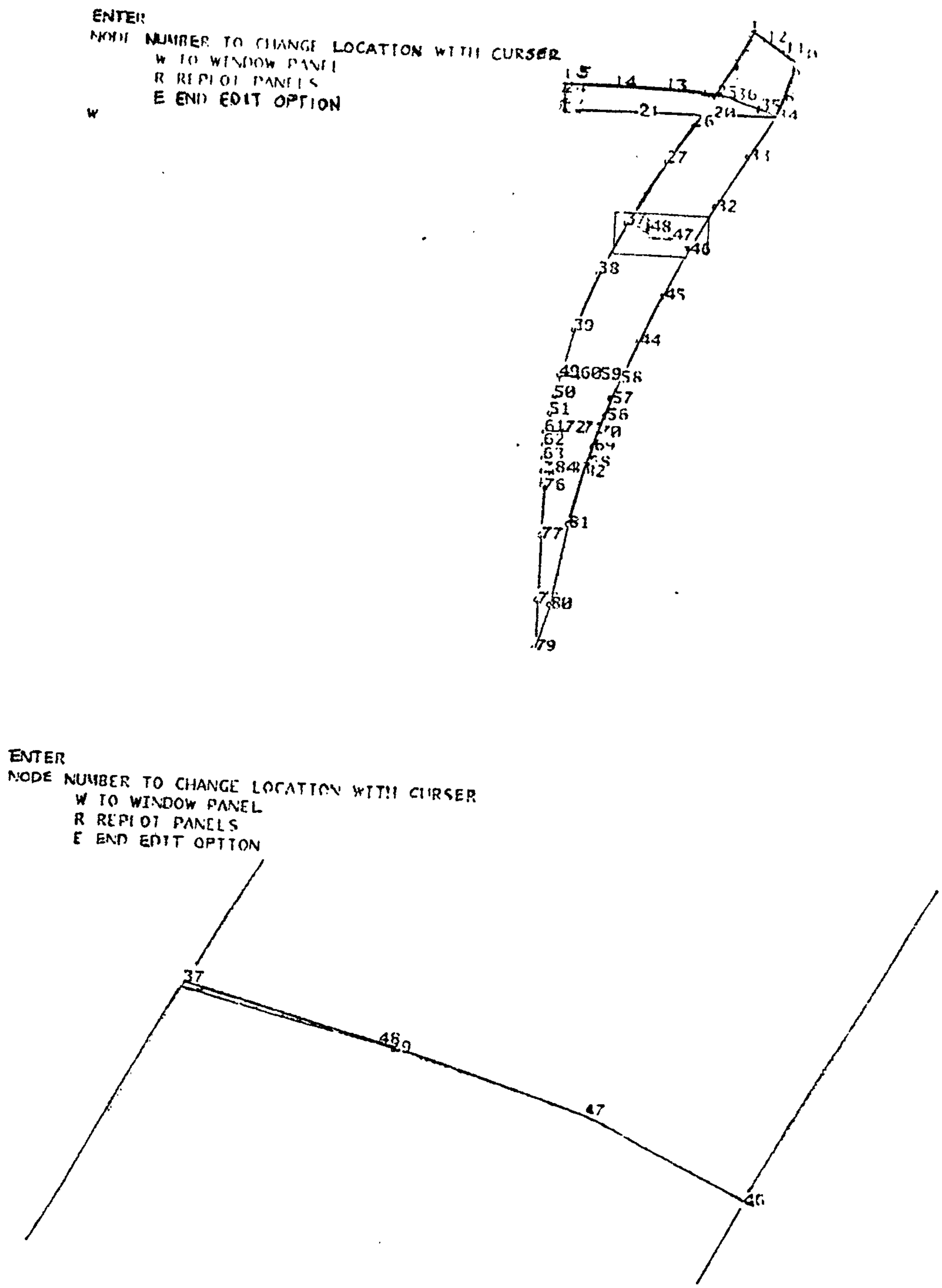


Figure 5.6: Editing Of Panel Nodes To Improve Panel To Panel Connection

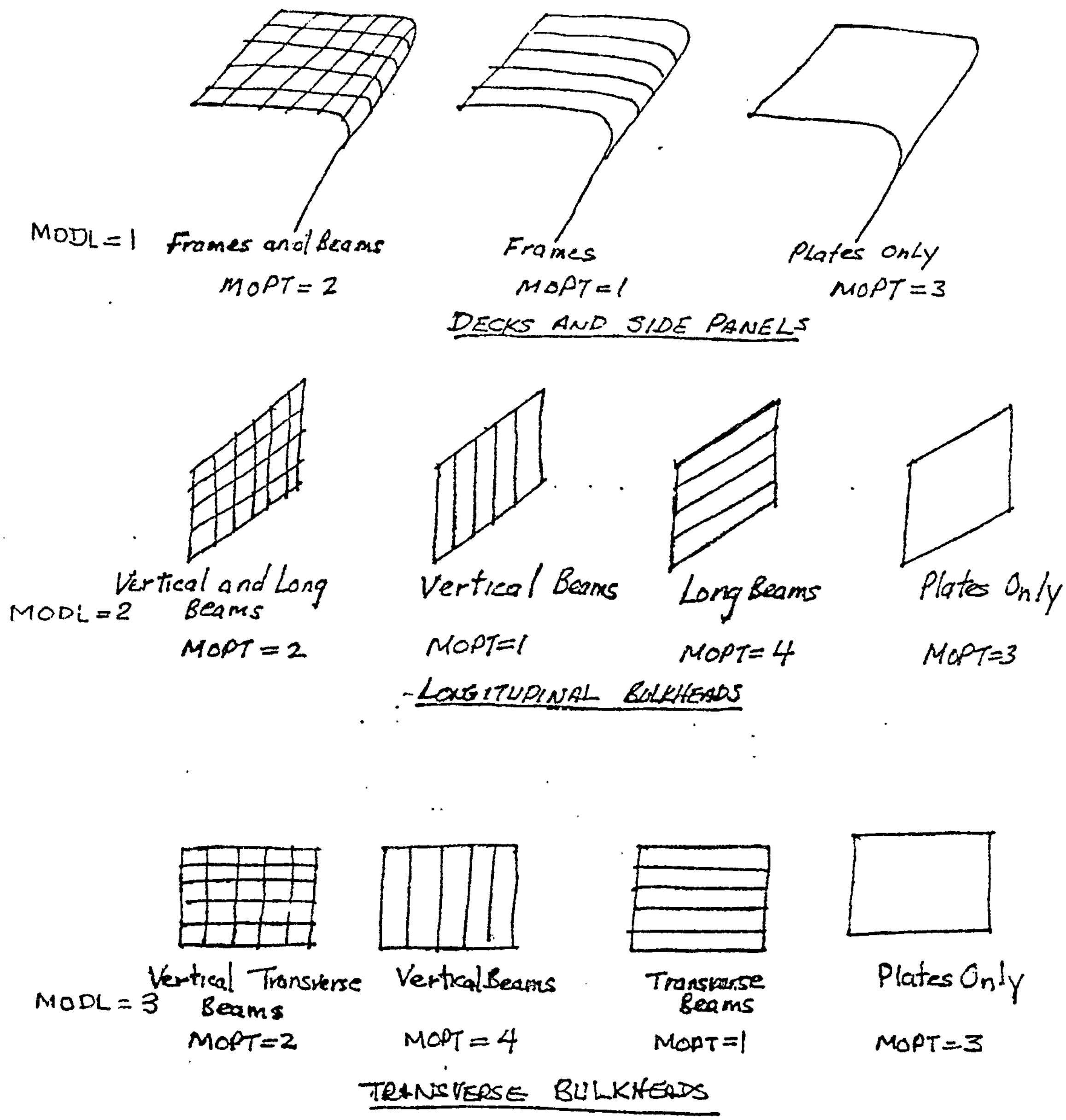


Figure 5.7: Panel Gridding Options

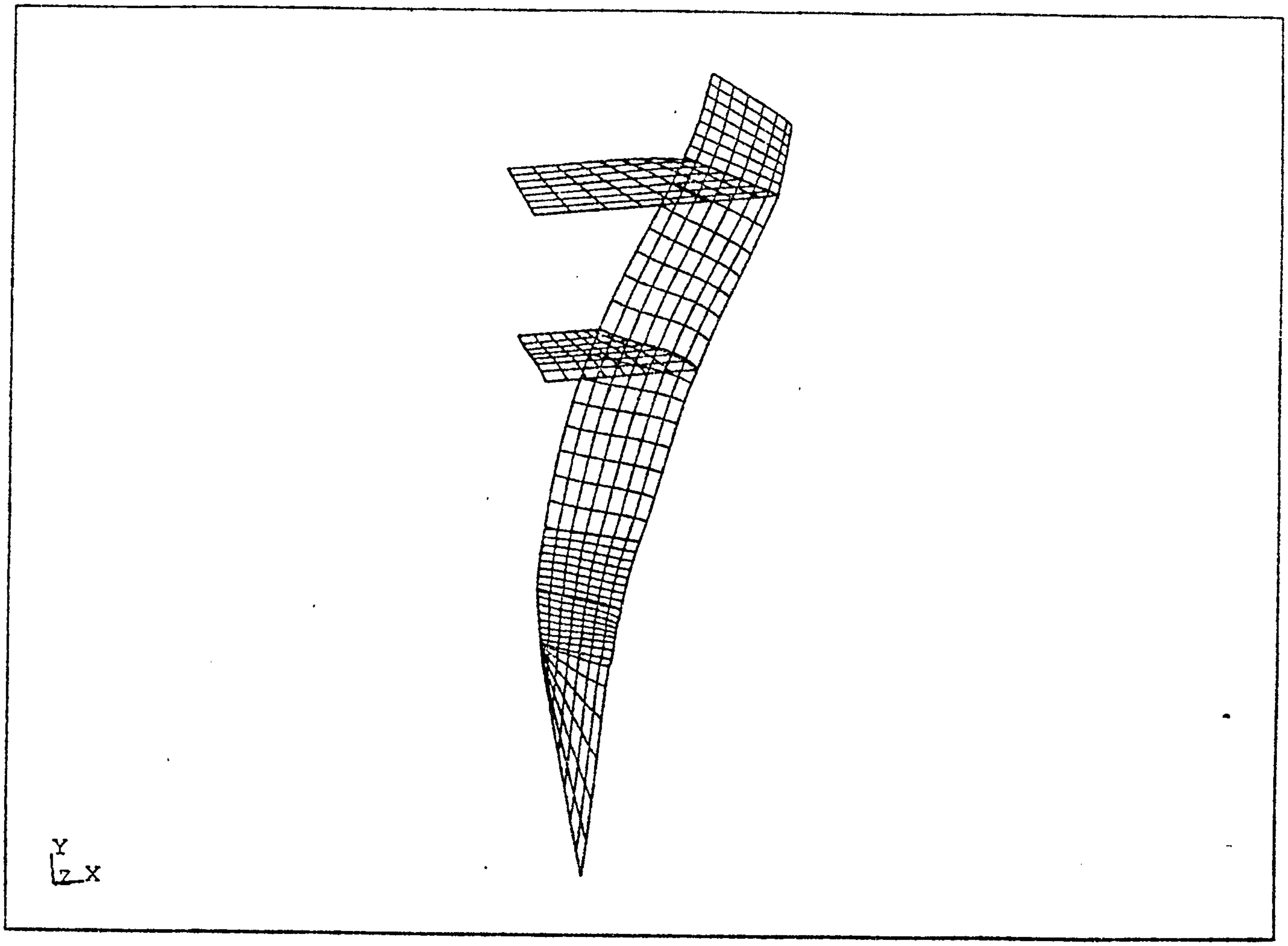


Figure 5.8: Display Of Gridded Panel For Inspection

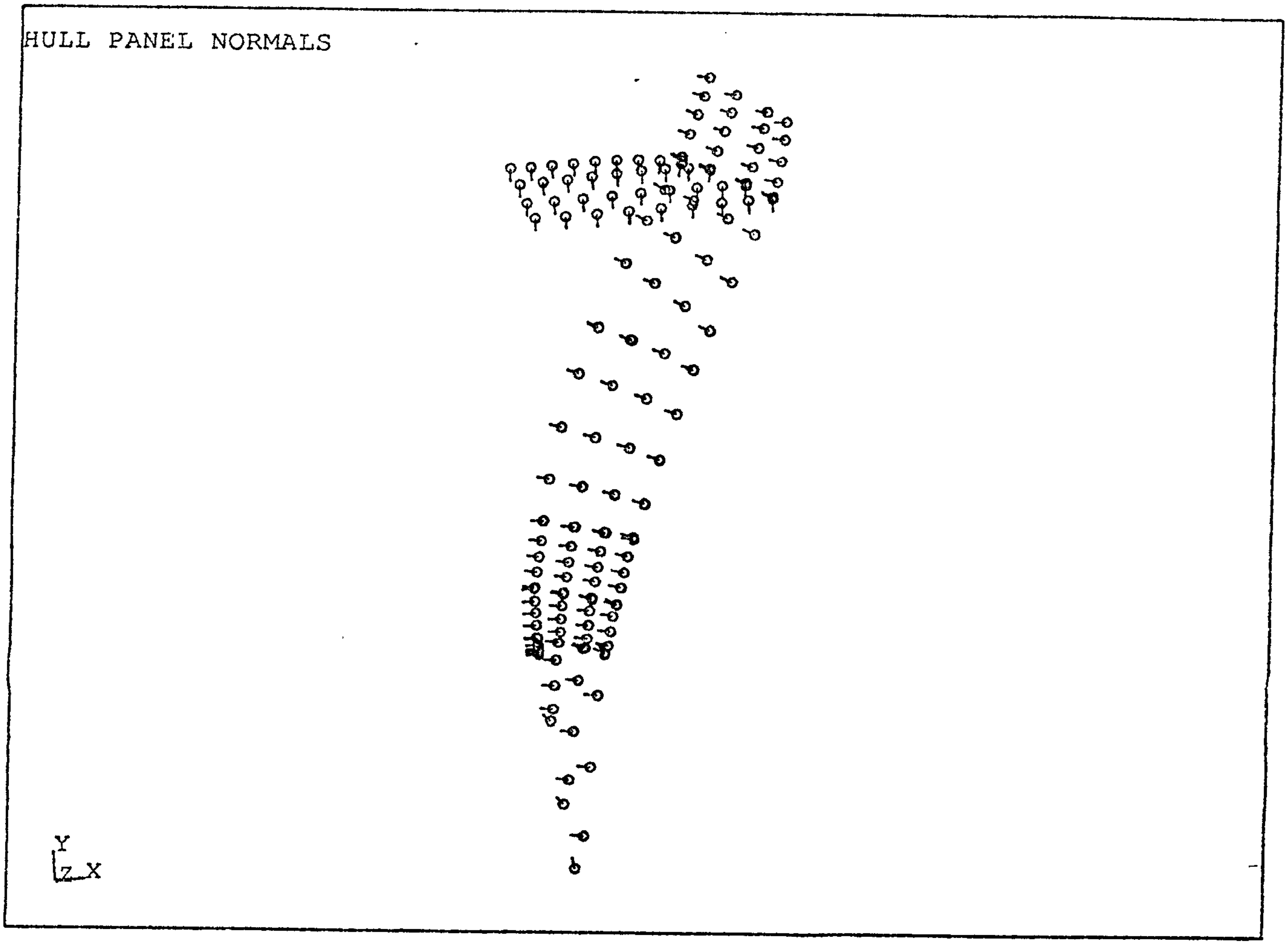


Figure 5.9: Plot Of Normals To Show Sides Of Panels On Which Beams Are Located

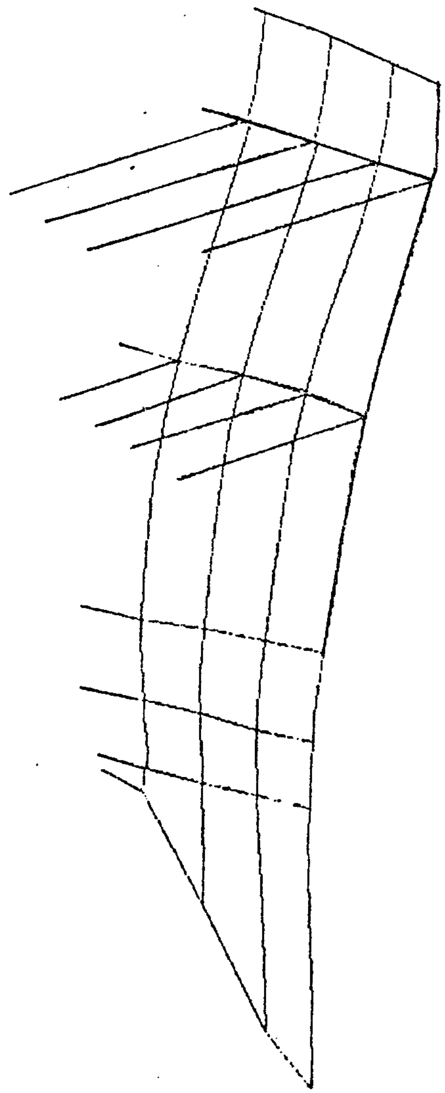


Figure 5.10: Display Of Panel Beams To Check For Duplicate Beams

Chapter 6

Option 2: Section Plot, Beam Normals, Duplicate Beams, Loads, and Boundary Conditions

At this stage one or more sections have been created with panels. This option will allow any of the existing sections to be plotted. It will also allow for the generation of VAST geometry, boundry condition, and load files, SHPHL.GOM, SHPHL.SMD, and SHPHL.LOD, for an individual section or an assembled model. Panel normals can be displayed and the panel beam grids can be checked. In this chapter only VAST geometry file generation and boundary conditions and loading will be demonstrated.

6.1 Single Section VAST Geometry File And Boundary Conditions

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
 2 = GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
```

```
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
2
```

The terminal session for option 2 has been chosen to illustrate the generation of a VAST finite element model file of a chosen section followed by the selection of boundary conditions. The model is plotted first to check that it is the correct one.

```
ENTER
FOR SINGLE SECTIONS
0 = TO PLOT SECTION MODEL, OR BEAM NORMALS
    TO CHECK PANEL BEAM GRIDS
    TO APPLY PANEL PRESSURE LOADS
    TO GENERATE A VAST FILE AND BOUNDARY CONDITIONS

FOR ASSEMBLED SECTIONS
1 = APPLY LOADING TO ASSEMBLED SECTION GEOMETRY FILES
2 = APPLY BOUNDARY CONDITIONS TO ASSEMBLED SECTION GEOMETRY FILES
0
```

6.1.1 Plot A Section

The following prompts provide the ability to plot any section that exists as a FRAME.DXX file.

```
ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 90. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
2
```

```
READING FILE FRAME.D02
PROCESSING SECTION 2

PLOT SECTION MODEL 2
 0 = YES
 1 = NO
0

CHOOSE THE PLANE IN WHICH DECKS ARE TO BE DISPLAYED
1 =  LENGTH OF SHIP ALONG X AXIS
2 =  LENGTH OF SHIP ALONG Z AXIS
2

ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10

0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
1

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The section model is displayed in Figure 6.1 for inspection.

6.1.2 Generate A VAST File For The Section

On completion of the plot the program displays the following prompt.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE AND BOUNDARY CONDITIONS FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
5
```

The option to generate a finite element model in the format of a VAST analysis file has been chosen.

```
CHOOSE TYPE OF PLATE ELEMENT
4 = 4 NODE QUAD
3 = 3 NODE TRIANGLE
4

CHOOSE FROM FOLLOWING
0 = MODEL AS A SINGLE STRUCTURE
1 = MODEL AS 2 LEVEL SUBSTRUCTURE
2 = CREATE SUBSTRUCTURED MODEL USING UNITE
0
```

The option to treat the section as a single unsubstructured model has been chosen. As a result a SHPHL.GOM file has been be created.

```
ENTER THE ANGLES OF ROTATION ABOUT X Y Z AXES
TO DISPLAY MODEL
0 0 0
```

The model will be displayed for inspection and specification of the boundary conditions for the analysis. If boundary conditions are to be specified then the viewing angles should be chosen with this in mind although they can be changed later during the boundary specification procedure.

```
1 = PLOT TO PREVIEW MODEL
2 = PLOT MODEL AND LOCATE BOUNDRY CONSTRAINTS WITH CURSOR
3 = RETURN TO MAIN MENU
2

DEFINITION OF RESTRAINTS
SELECT THE NODE OR NODES TO BE RESTRAINED BY WINDOWING
 F FINISHED DEFINITIONS
 W WINDOW MORE NODES
 X EXPAND VIEW
 R REDEFINE BOUNDARY CONDITIONS
 N NEW VIEW
 E ERROR
```

PRESS RETURN

At this stage the section finite elements will be plotted for constraint definition as shown in Figure 6.2. On completion of the plot the model can be expanded or a region enlarged by entry of the letter X and windowing to show more detail for easier application of boundary conditions. If windowed for enlargement the screen will be erased and the enlarged view will appear. Whether enlarged or not a carriage return, after the display, will produce the following prompt.

```
ENTER
RESTRAINT CONDITIONS (1 OR 0) 6
VALUES NO SPACES
AND WINDOW NODES
101011
```

The code for boundary nodal constraint uses 1 in the first three characters to show constraint against translations in X,Y and Z. The last three characters show constraint against rotation about X,Y and Z. The entry indicates constraint against translation in X and Z and against rotation in Y and Z. The screen cursor appears after a carriage return following the entry of the restraint conditions. The cursor is used to window nodes where the constraints are to be applied. A window is created by moving the cursor to what is to be the lower left corner, and pressing the letter P, then moving to the upper right corner and again entering P. The window outline appears and the number of the nodes, to which constraints have been applied, will be displayed. Additional windows can be created by the entry of W after the node numbers appear.

Instead of W a R can be entered which will result in a prompt for new constraint conditions. The entry of an N will result in the erasure of the plot and the request for new angles of rotation. A new view of the model will be displayed with the selected node numbers and a prompt for constraints. Additional windows can be placed to assign more boundary conditions.

```
N

ENTER THE ANGLES OF ROTATION ABOUT X Y Z AXES
TO DISPLAY MODEL
0 90 0
```

```
ENTER RESTRAINT CONDITIONS (1 OR 0)
6 VALUES NO SPACES
AND WINDOW NODES
100011
```

The model is shown in a new position with the boundary nodes, on which constraints are imposed, indicated by the character as shown in Figure 6.3. Futher windowing along the model boundaries has generated additional constraint conditions. When the windowing is completed the entry F will end the procedure and display the following prompt.

```
0 CREATE CONSTRAINT FILE
1 DISPLAY CONSTRAINED NODES
2 ADD CONSTRAINTS WITH CURSOR
3 DELETE CONSTRAINTS WITH CURSOR
4 EDIT DATA LIST
1
```

The boundary constraints can be displayed or edited at this stage. Editing is carried out by windowing the nodes, to be deleted or added, by actually editing the data list of constraints for each node. They appear as ones or zeros for each degree of freedom. The option to display the constrained nodes, when chosen, produces the following prompt requesting viewing angles.

```
ENTER THE ANGLES OF ROTATION ABOUT X Y Z AXES
TO DISPLAY MODEL
45 45 45
```

The model is shown in Figure 6.4 with the nodes numbered to which constraints have been applied.

```
0 CREATE CONSTRAINT FILE
1 DISPLAY CONSTRAINED NODES
2 ADD CONSTRAINTS WITH CURSOR
3 DELETE CONSTRAINTS WITH CURSOR
4 EDIT DATA LIST
0
```

After viewing and or editing is satisfied the constraint file SHPXX.SMD is created by chosing option zero. The constraint file can be created in accordance with the global axis system or in the form of skewed coordinates. The skewed coordinates should be chosen if there are curved edges so that the rotations will be constrained in the local coordinate system of the plate or beam nodes along the edges.

```
ENTER
1 TO GENERATE SKEWED COORDINATES AT CONSTRAINED NODES
0 TO CONTINUE
1

 CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16

VAST FILE STORED ON FILE SHPHL.GOM
FORTRAN STOP
```

The model has been created and stored on file. It can be checked for compatibility with VAST by plotting it with VASTG6 [6]as shown in Figure 6.5. The constraints, which are applied in this case in accordance with the skewed coordinates, can also be checked by plotting as shown in Figure 6.6.

6.2 Single Section Load File

The model of the section can be loaded at this stage by continuing to use Option 2.

```
 CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
 2 = GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = STOP
2

ENTER
FOR SINGLE SECTIONS
0 = TO PLOT SECTION MODEL, OR BEAM NORMALS
    TO CHECK PANEL BEAM GRIDS
    TO APPLY PANEL PRESSURE LOADS
    TO GENERATE A VAST FILE AND BOUNDARY CONDITIONS

FOR ASSEMBLED SECTIONS
1 = APPLY LOADING TO ASSEMBLED SECTION GEOMETRY FILES
2 = APPLY BOUNDARY CONDITIONS TO ASSEMBLED SECTION GEOMETRY FILES
0

ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 30. THEY MAY BE ENTERED IN ANY ORDER
```

```
** ENTER S TO STOP **
2
READING FILE FRAME.D02
PROCESSING SECTION 2

PLOT SECTION MODEL 2
 0 = YES
 1 = NO
1
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
7
CHOOSE TYPE OF PLATE ELEMENT
4 = 4 NODE QUAD
3 = 3 NODE TRIANGLE
4
0

ENTER C TO CONTINUE
      L LOAD FORM REFERENCE PLOTS
      W FOR STILL WATER LINE LOAD
      P WAVE PROFILE LOAD
L

FOR LOAD FORMS AVAILABLE
ENTER H FOR HYDROSTATIC HEADS
      D ENVIRONMENTAL DECK LOADS
      F FLOODING LOADS
      S SAGGING LOADS
      G HOGGING LOADS
      B BOUNDARY CONDITIONS
      A ALL FORMS IN SEQUENCE
      E END PLOTTING
A
```

The standard loading cases are shown in Figure 6.7, Figure 6.8,Figure 6.9, Figure 6.10, and Figure 6.11.

```
FOR LOAD FORMS AVAILABLE
ENTER H FOR HYDROSTATIC HEADS
      D ENVIRONMENTAL DECK LOADS
      F FLOODING LOADS
      S SAGGING LOADS
      G HOGGING LOADS
      B BOUNDARY CONDITIONS
      A ALL FORMS IN SEQUENCE
      E END PLOTTING
E

ENTER
0 = LOAD A SINGLE HULL SECTION
1 = LOAD AN ASSEMBLY OF HULL SECTIONS
0

SELECT GRAVITY AXIS AND DIRECTION
1 = X  2 = -X
3 = Y  4 = -Y
3

ENTER G FORCE MULTIPLIER
      1 FOR SELF WEIGHT
1
ENTER THE ANGLES OF ROTATION ABOUT X Y Z AXES
TO DISPLAY MODEL FOR LOADED PANEL SELECTION
10 10 10


SELECT PANELS TO BE LOADED FROM THOSE PLOTTED IN SEQUENCE
UNLOADED PANELS WILL BE SUBJECTED TO GRAVITY LOADS ONLY
ENTER
 P TO SAVE PANEL
 R TO REJECT
```

The panels that are loaded are defined to identify element groups and to prevent accidential loading of panels that may be hidden. An example of the plotting of selected of panels is shown in Figure 6.12.

```
ENTER THE ANGLES OF ROTATION ABOUT X Y Z AXES
TO DISPLAY MODEL FOR STILL WATER LOADING
0 -90 0
```

A Y axis rotation of -90 was chosen to place the hydrostatic pressure on the outside of the hull.

```
WINDOW THE PRESSURE LOADED AREA ON THE FOLLOWING PLOT
BOTTOM LEFT AND TOP RIGHT
PRESS R FOR RETURN
R
```

The windowed area of the loaded panels is shown in Figure 6.13.

```
 CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
```

```
FORTRAN STOP
```

The loading process has been completed with the data stored on SHPHL.LOD. The pressure loading can be checked by plotting the data with VASTG6 as shown in Figure 6.14.

6.3 Assembled Sections Boundary Condition Definition

A series of single hull section geometry files can be assembled to form a model of the hull or a large portion of it by the use of the program VASGEN. The assembled model may be assigned boundary conditions through the use of option 2. This capability considerably reduces the effort required to generate a boundary condition file. This is especially true in the case of half models such as shown plotted by VASTG in Figure 6.15. The procedure for generating the boundary condition file is demonstrated in the following terminal session.

```
 CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
2

ENTER
FOR SINGLE SECTIONS
```

```
0 = TO PLOT SECTION MODEL, OR BEAM NORMALS
    TO CHECK PANEL BEAM GRIDS
    TO APPLY PANEL PRESSURE LOADS
    TO GENERATE A VAST FILE AND BOUNDARY CONDITIONS

FOR ASSEMBLED SECTIONS
1 = APPLY LOADING TO ASSEMBLED SECTION GEOMETRY FILES
2 = APPLY BOUNDARY CONDITIONS TO ASSEMBLED SECTION GEOMETRY FILES
2

ENTER THE FIVE CHARACTER NAME OF THE ASSEMBLED
SECTIONS VAST GEOMETRY FILE
SHPHF
```

The five character name of the assembled model must be entered. A VASTG plot of the model is shown in Figure 6.15.

```
ENTER THE ANGLES OF ROTATION ABOUT X Y Z
TO DISPLAY THE MODEL
90 0 0

1 = PLOT TO PREVIEW MODEL
2 = PLOT MODEL AND LOCATE BOUNDRY CONSTRAINTS WITH CURSOR
3 = RETURN TO MAIN MENU
2

DEFINITION OF RESTRAINTS
SELECT THE NODE OR NODES TO BE RESTRAINED BY WINDOWING
 F FINISHED DEFINITIONS
 W WINDOW MORE NODES
 X EXPAND VIEW
 R REDEFINE BOUNDARY CONDITIONS
 N NEW VIEW
 E ERROR
PRESS RETURN
```

The model is shown displayed in Figure 6.16. A window was taken along the hull center line to assign the boundary constraints.

```
0 CREATE CONSTRAINT FILE
1 DISPLAY CONSTRAINED NODES
2 ADD CONSTRAINTS WITH CURSOR
3 DELETE CONSTRAINTS WITH CURSOR
4 EDIT DATA LIST
0

ENTER
1 TO GENERATE SKEWED COORDINATES AT CONSTRAINED NODES
0 TO CONTINUE
0
```

The boundary constraints file has been created as SHPHF.SMD. A plot of the constraints using VASTG is shown in Figure 6.17.

6.4 Assembled Sections Loading

The assembled sections forming the hull can be loaded using SHPHUL. A still waterline load may be applied or a balance-on-a-wave load can be selected. The balance-on-a-wave loading requires a wave profile file, PROFL.DAT, to be generated by the program POSBOW. The interactive version POSBOW.DRS[8] should be used in this case. In addition to the assembled model, in this example SHPTA.GOM, the section finite element geometry files from which the model was assembled must also be available. In the example, files SHP78.GOM to SHP88.GOM are required. The VAST load file generated is SHPTA.LOD. In addition to the pressure loads the file also contains the data for including the weight of the structure itself as a load. The following is a sample terminal sesssion of the procedure for loading the assembled structure.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT MODEL,TO CHECK ADJACENT SECTION EQUIVALENCING
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
```

```
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOM. FILES OF HULL SECTIONS FOR SUBSTRUCTURES
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = GENERATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED HULL SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
2


 ENTER
 FOR SINGLE SECTIONS
 0 = TO PLOT SECTION MODEL, OR BEAM NORMALS
     TO CHECK PANEL BEAM GRIDS
     TO APPLY PANEL PRESSURE LOADS
     TO GENERATE VAST FILE AND BOUNDARY CONDITIONS
        FOR ASSEMBLED SECTIONS
 1 = APPLY LOADING TO ASSEMBLED SECTION GEOMETRY FILES
 2 = APPLY BOUNDARY CONDITIONS TO ASSEMBLED SECTION GEOMETRY FILES
1

 ENTER C TO CONTINUE
       L  LOAD FORM REFERENCE PLOTS
       W  FOR STILL WATER LINE LOAD
       P  WAVE PROFILE LOADING
P

ENTER
 0 = LOAD A SINGLE HULL SECTION
 1 = LOAD AN ASSEMBLY OF HULL SECTIONS
1

SELECT HULL COMPONENTS TO BE LOADED
 1 = SIDES
 2 = BULKHEADS
```

```
 3 = DECKS
1

SELECT GRAVITY AXIS AND DIRECTION
 1 = X    2 = -X
 3 = Y    4 = -Y
3

ENTER G FORCE MULTIPLIER
      1 FOR SELF WEIGHT
1

ENTER THE RANGE OF THE SECTIONS ASSEMBLED
78 88

 READING FILE SHP78.GOM
 READING FILE SHP79.GOM
 READING FILE SHP80.GOM
 READING FILE SHP81.GOM
 READING FILE SHP82.GOM
 READING FILE SHP83.GOM
 READING FILE SHP84.GOM
 READING FILE SHP85.GOM
 READING FILE SHP86.GOM
 READING FILE SHP87.GOM
 READING FILE SHP88.GOM

 ENTER THE 5 CHARACTER PREFX OF THE GEOMETRY FILE NAME
 OF THE ASSEMBLED MODEL
SHPTA

READING FILE SHPTA.GOM

 BALANCE ON A WAVE LOADING
 0 = WAVE PROFILE ESTIMATED FROM WAVE HEIGHT FORMULA
 1 = WAVE PROFILE FROM POSBOW PROGRAM
1

    WAVE HEIGHT DATA IN IN.
```

```
 ENTER  0  TO CONTINUE  S  TO STOP
0

 ENTER
 0 = AUTOMATICALLY APPLY PRESSURE LOAD
 1 = DEFINE PRESSURE LOAD WITH WITH CURSOR
0

 WAVE PROFILE FOR INSPECTION
 ENTER C TO CONTINUE
 1 = DEFINE PRESSURE LOAD WITH WITH CURSOR
C
```

The hull model with the wave profile superimposed on it for inspection is shown in Figure 6.18.

```
 ENTER A TITLE FOR THE LOADING CASE (MAX 62 CHAR)
 BALANCE-ON-A-WAVE HULL LOADING

 WRITING LOAD FILE SHPTA.LOD

 The VAST load file has been created

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT MODEL,TO CHECK ADJACENT SECTION EQUIVALENCING
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOM. FILES OF HULL SECTIONS FOR SUBSTRUCTURES
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
```

```
13 = GENERATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED HULL SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
```

The pressure load plotted using VASTG is shown in Figure 6.19.

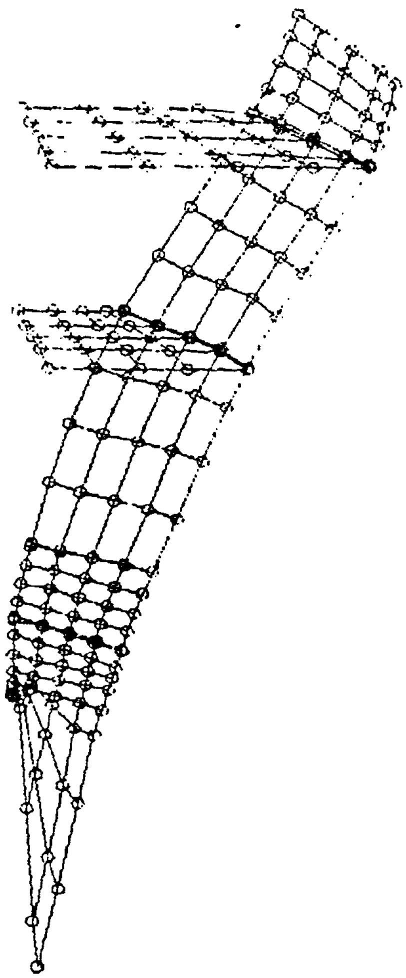


Figure 6.1: Plot Of Model Grid Of Section 2

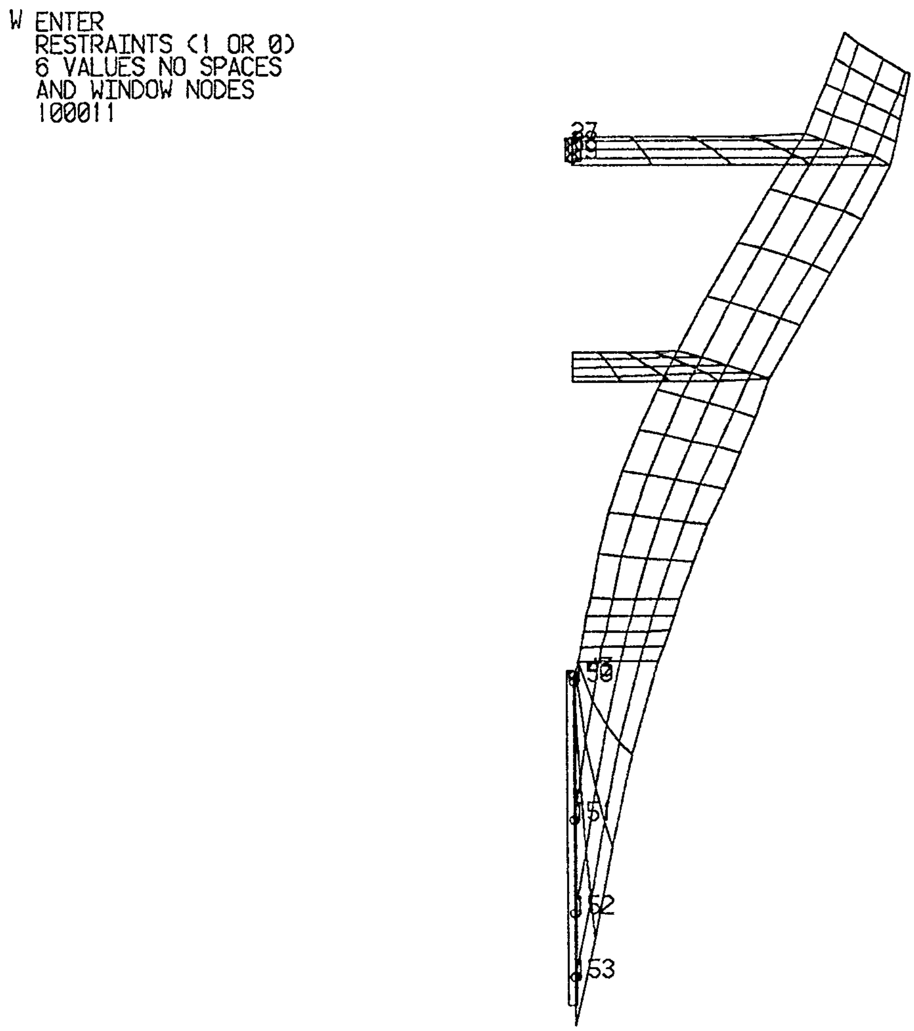


Figure 6.2: Plot Of The Model Showing The Nodes Constrained By Windowing

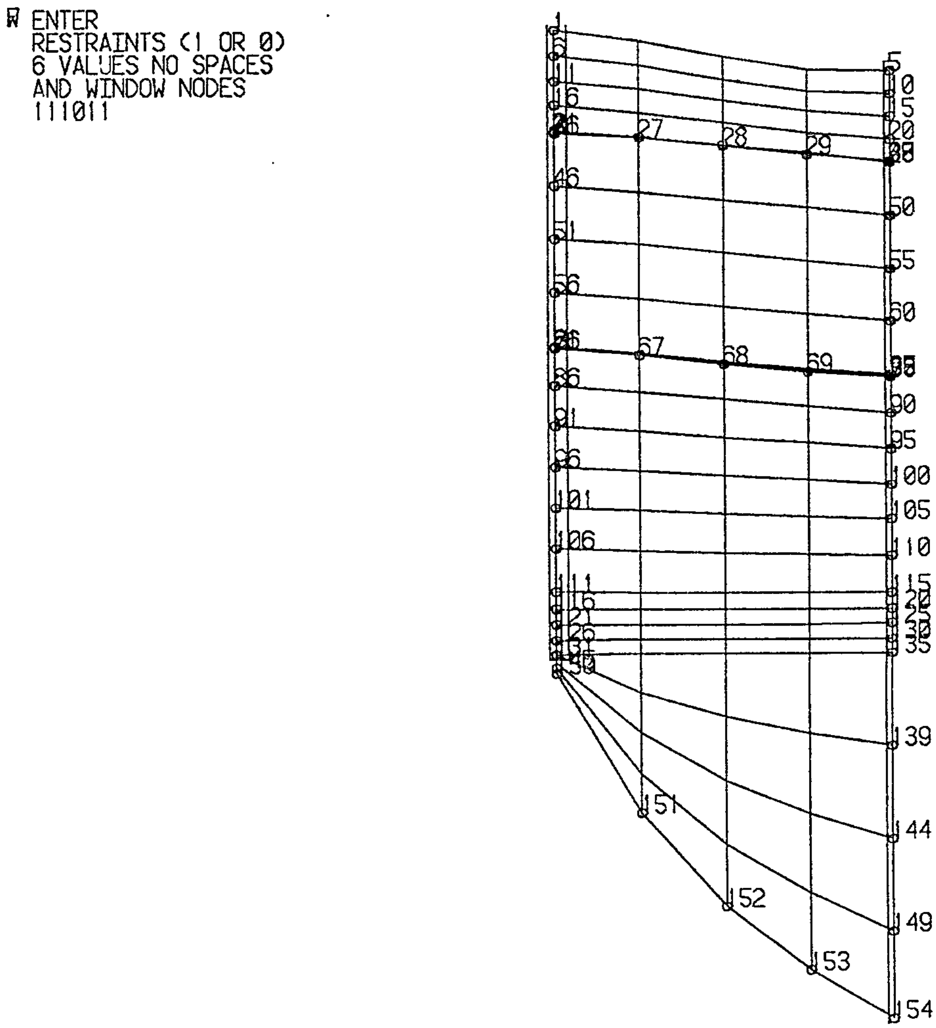


Figure 6.3: The Model Rotated To A New Position For Further Application Of Constraints

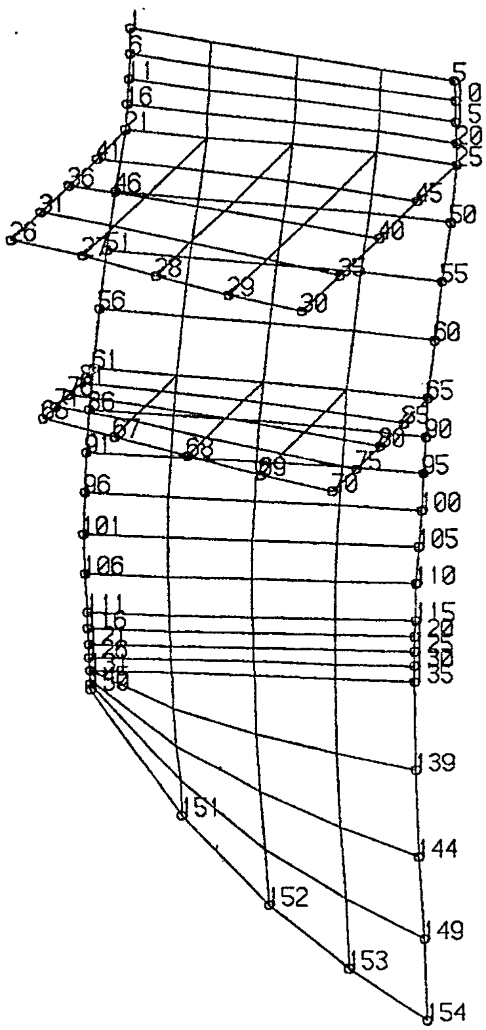


Figure 6.4: The Model Rotated To Show The Nodes To Which Constraints Are Applied

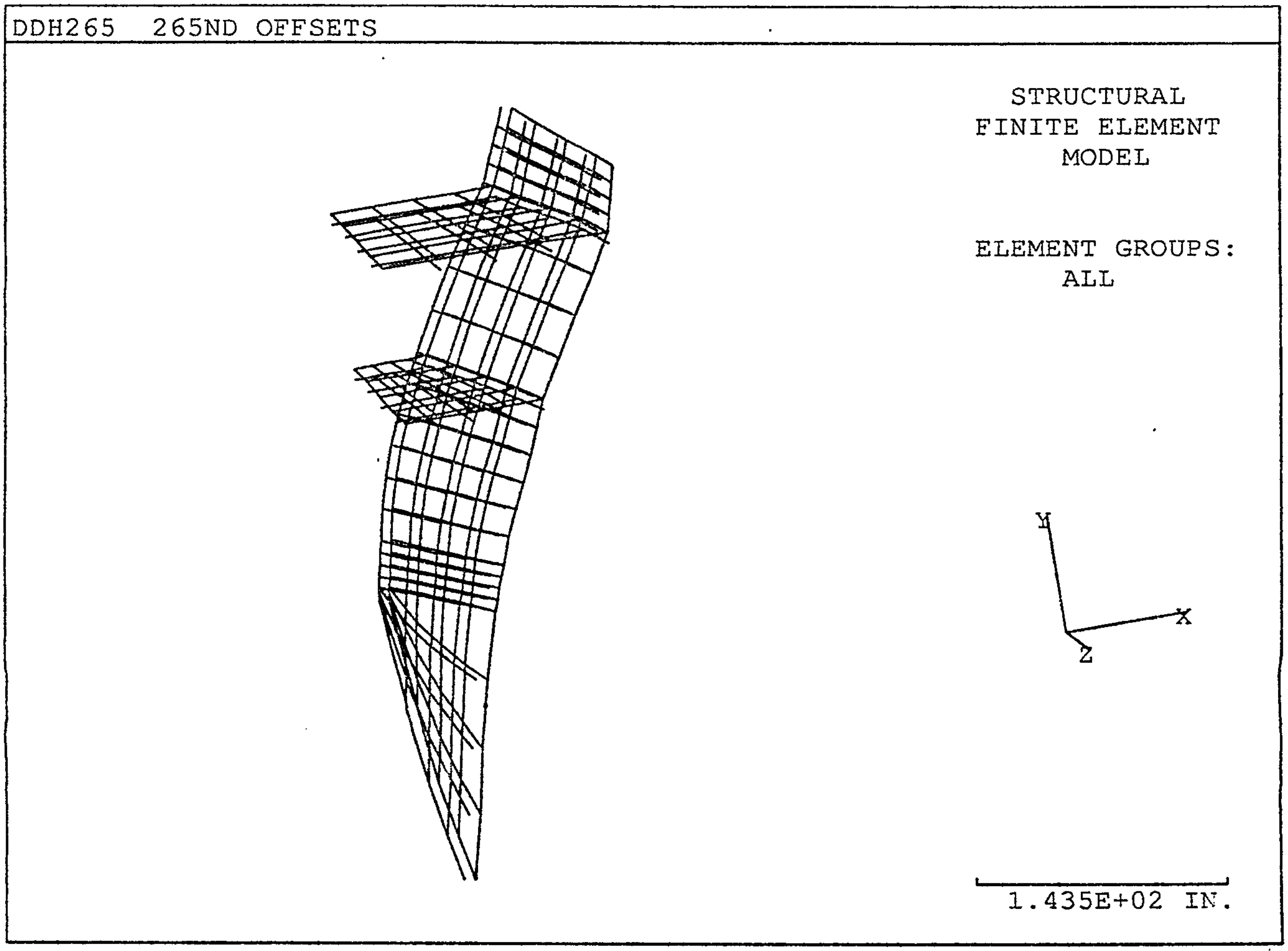


Figure 6.5: VASTG Plot Of The Finite Element Model For Section 2

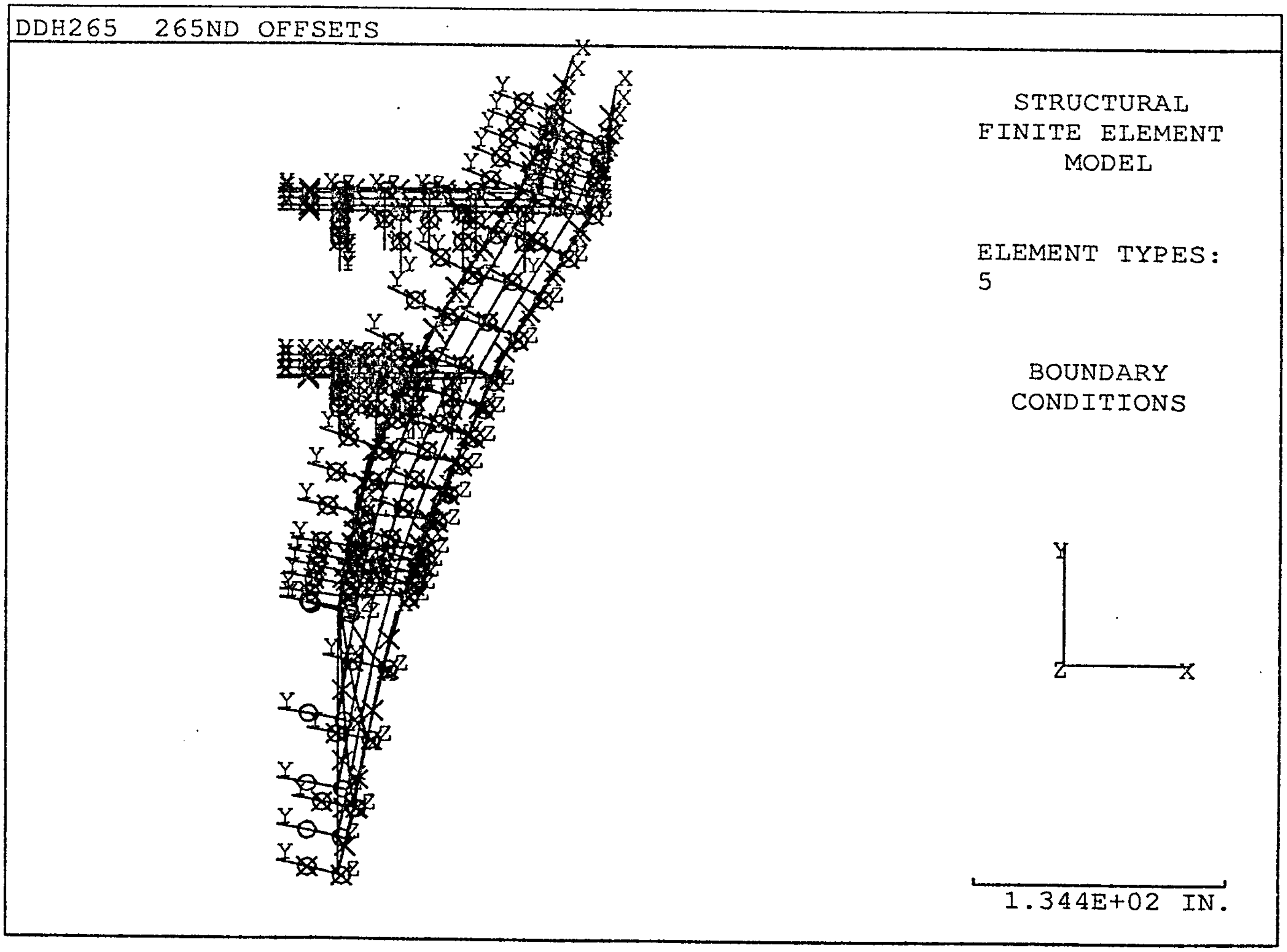


Figure 6.6: VASTG Plot Of The Boundary Conditions Using Skewed Coordinates

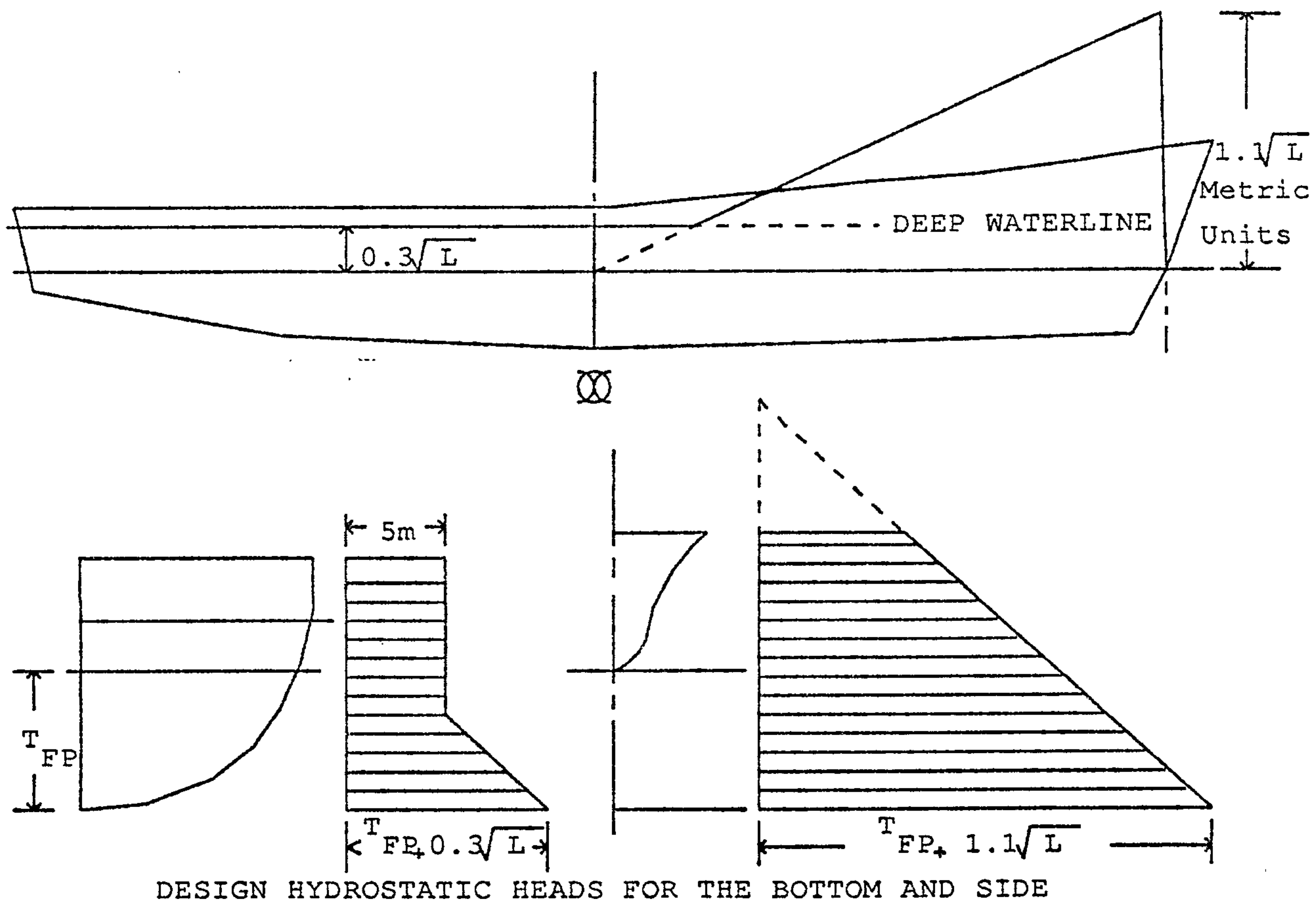


Figure 6.7: Hydrostatic Head Loads

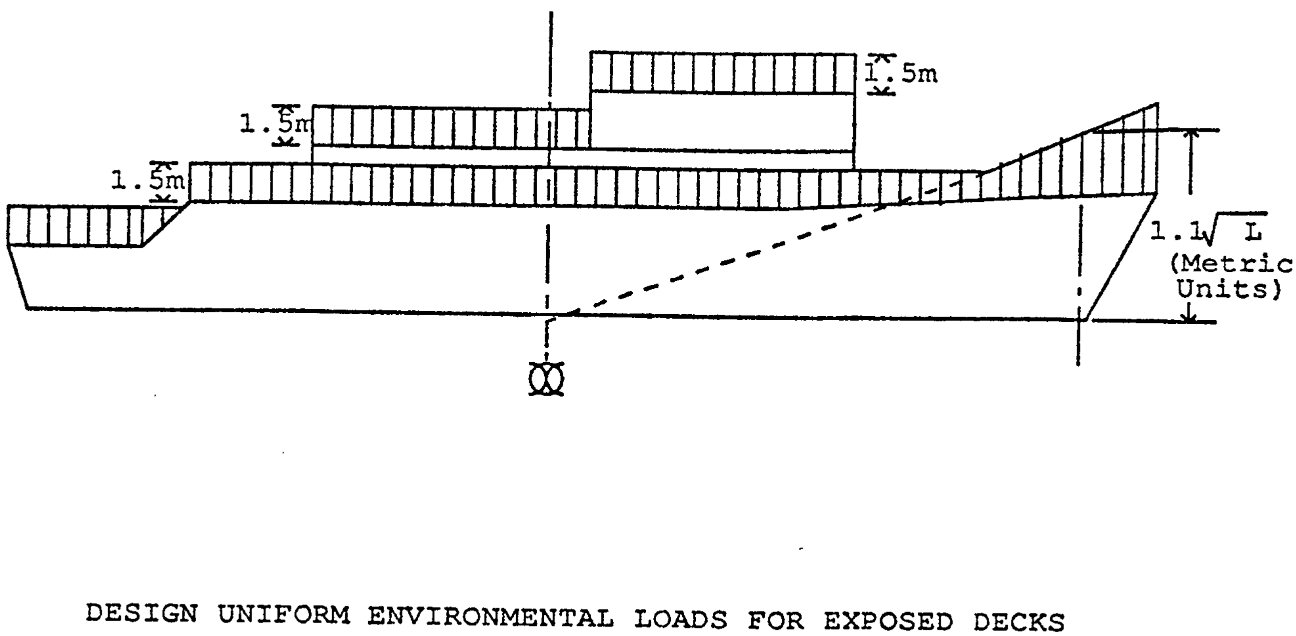
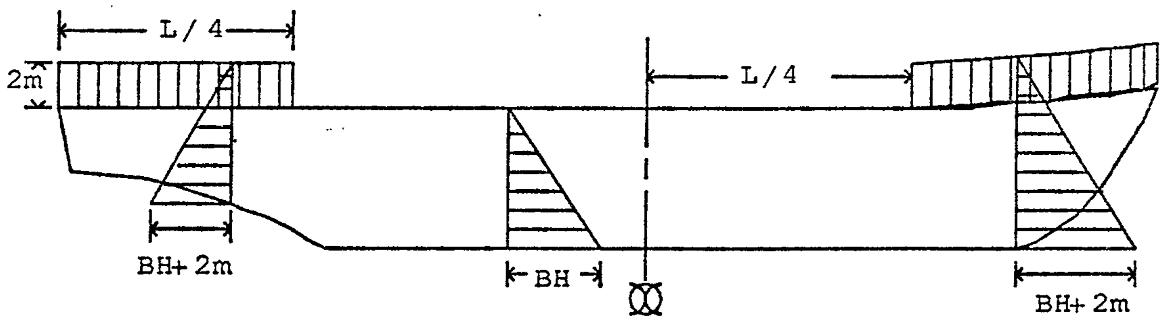
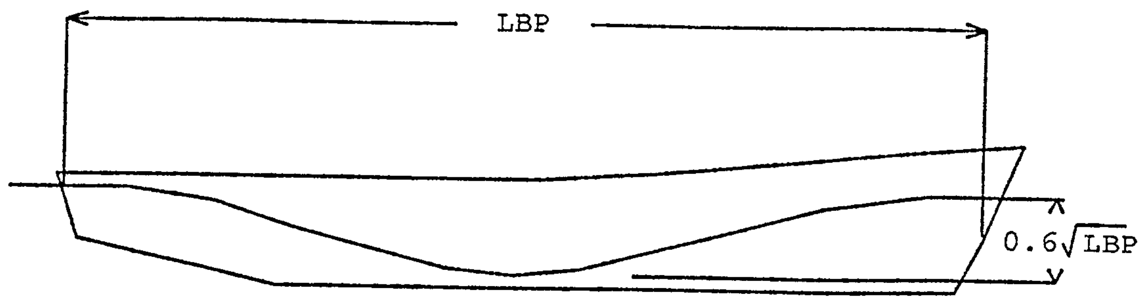


Figure 6.8: Environmental Deck Loads



DESIGN FLOODING PRESSURES FOR WATERTIGHT BULKHEADS

Figure 6.9: Flooding Loads



SAGGING

Figure 6.10: Sagging Loads

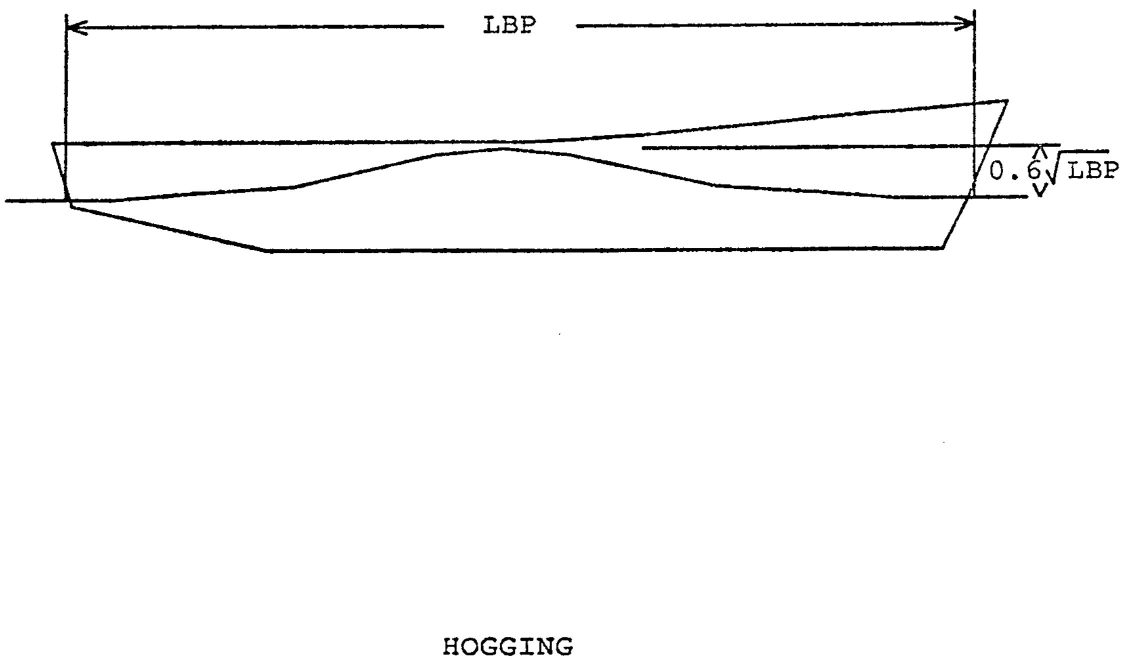


Figure 6.11: Hogging Loads

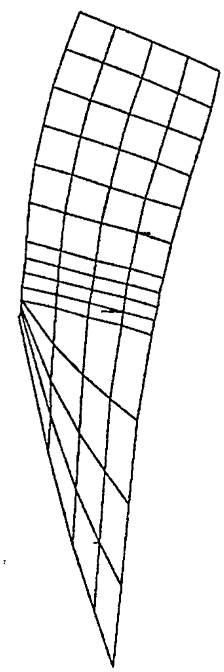


Figure 6.12: Identification Of Loaded Panels

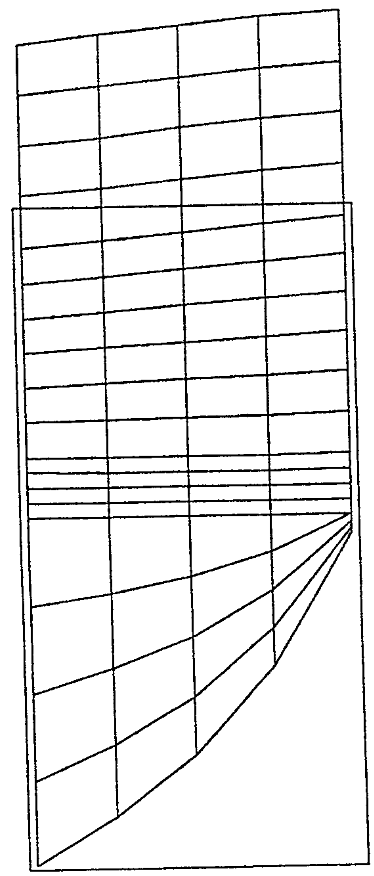


Figure 6.13: Defining Loaded Area On The Panels

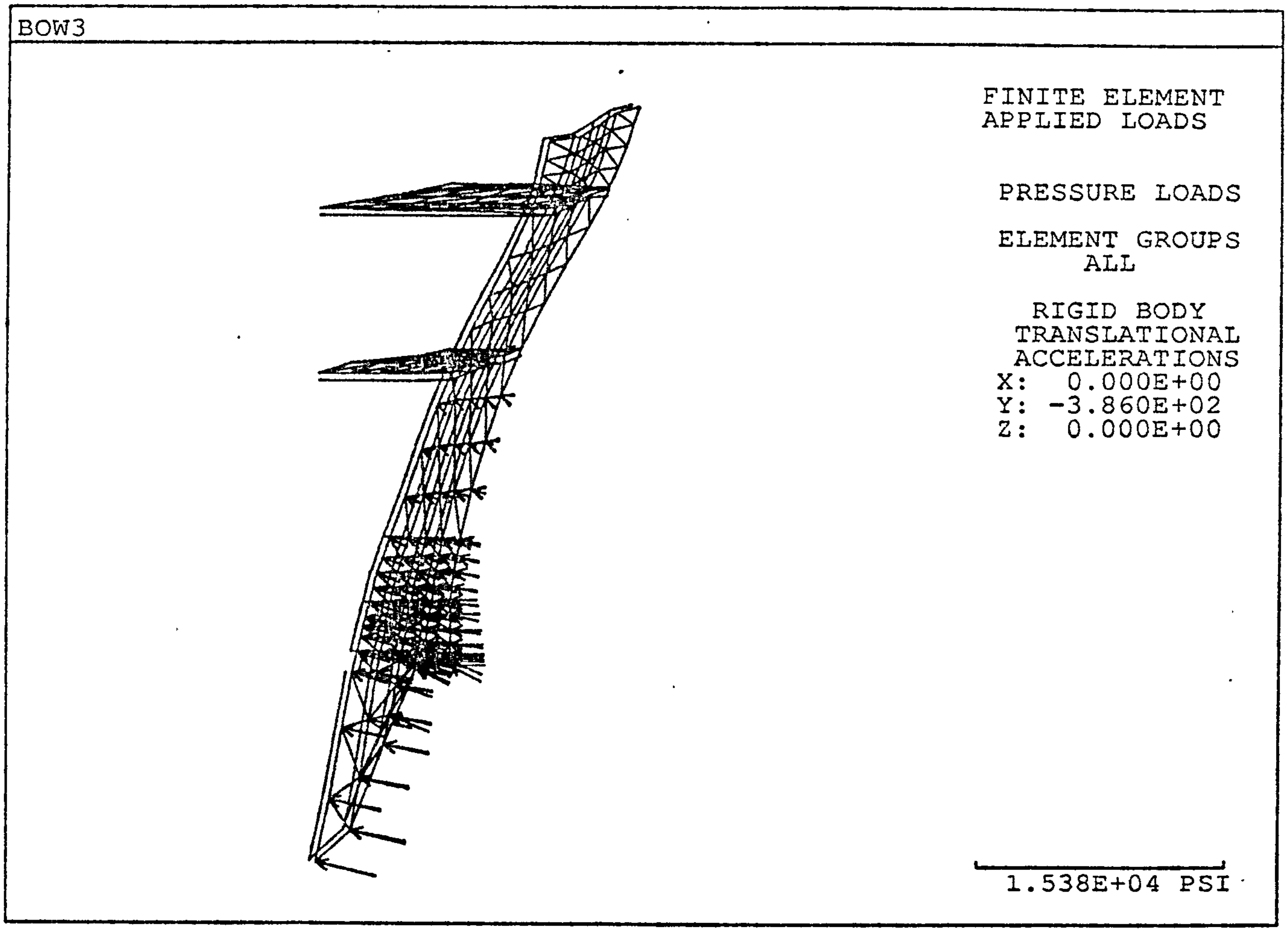


Figure 6.14: VASTG6 Plot Of Pressure Load On Section Panels

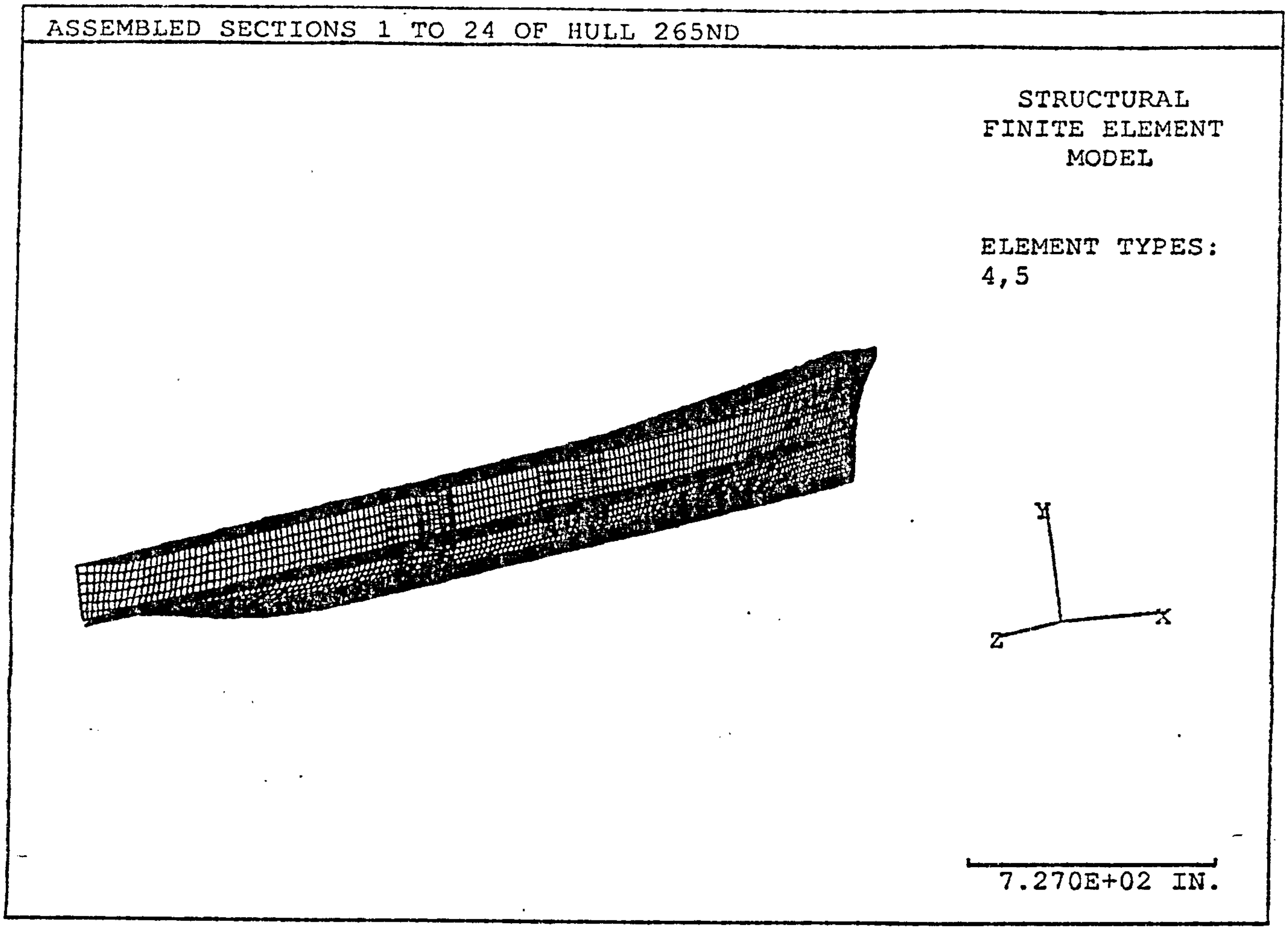


Figure 6.15: VASTG Plot Of An Assembled Half Model

Figure 6.16: Plot Of The Assembled Half Model Rotated And Windowed To Locate Constraints

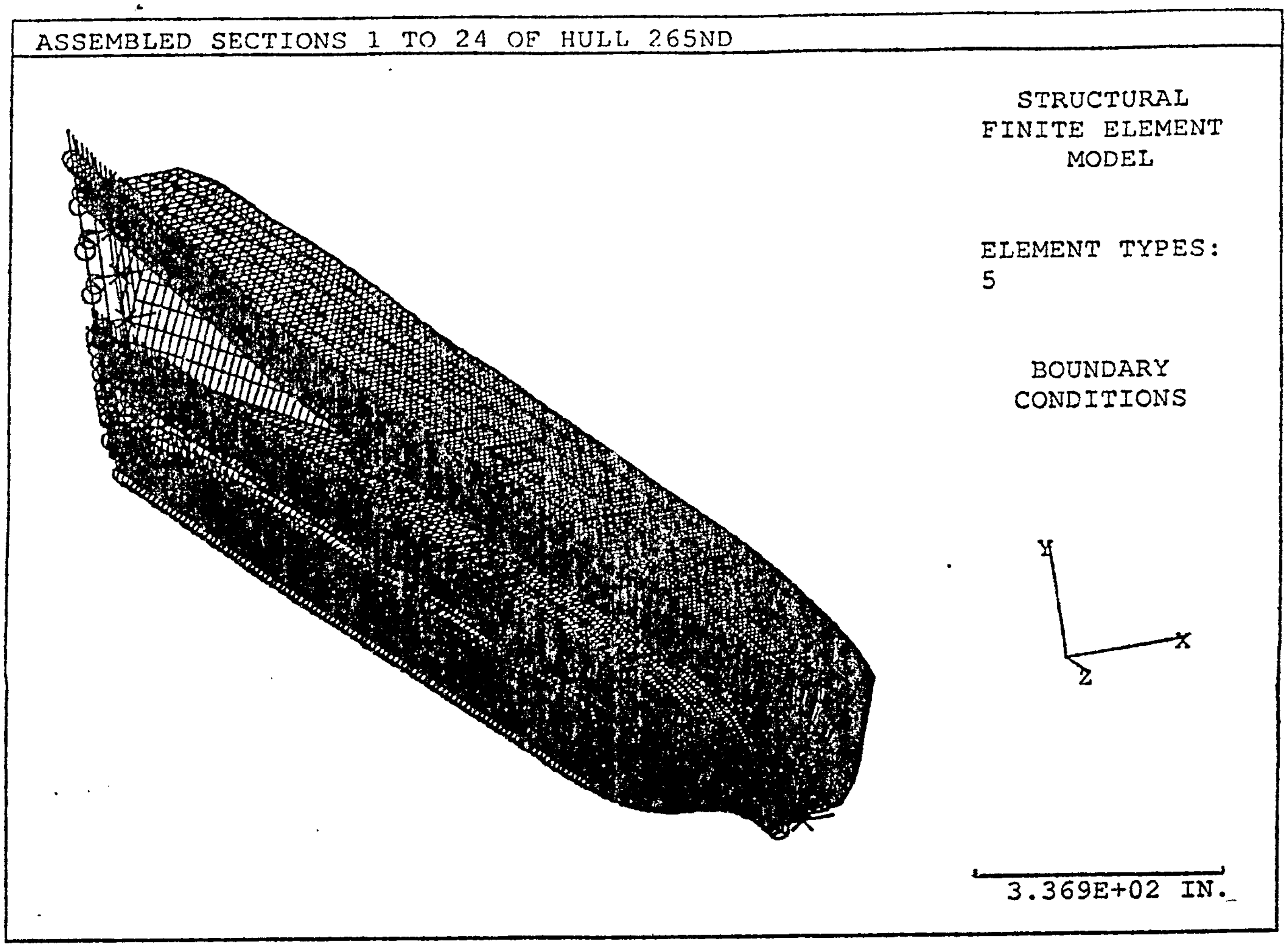


Figure 6.17: VASTG Plot Of The Assembled Half Model Showing The Applied Constraints

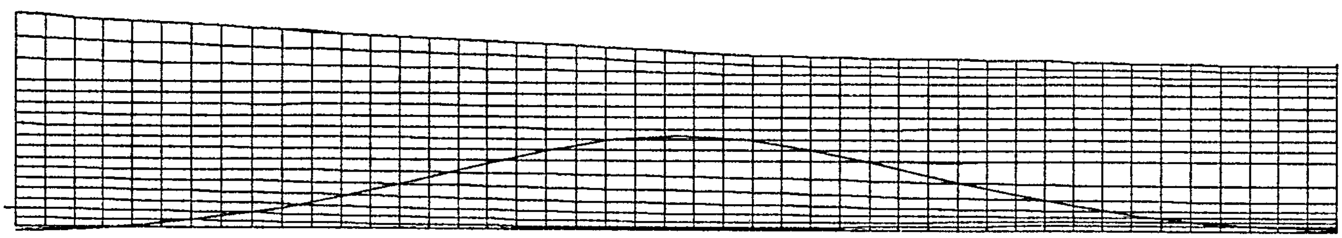


Figure 6.18: Hull Model With Wave Profile Superimposed For Inspection

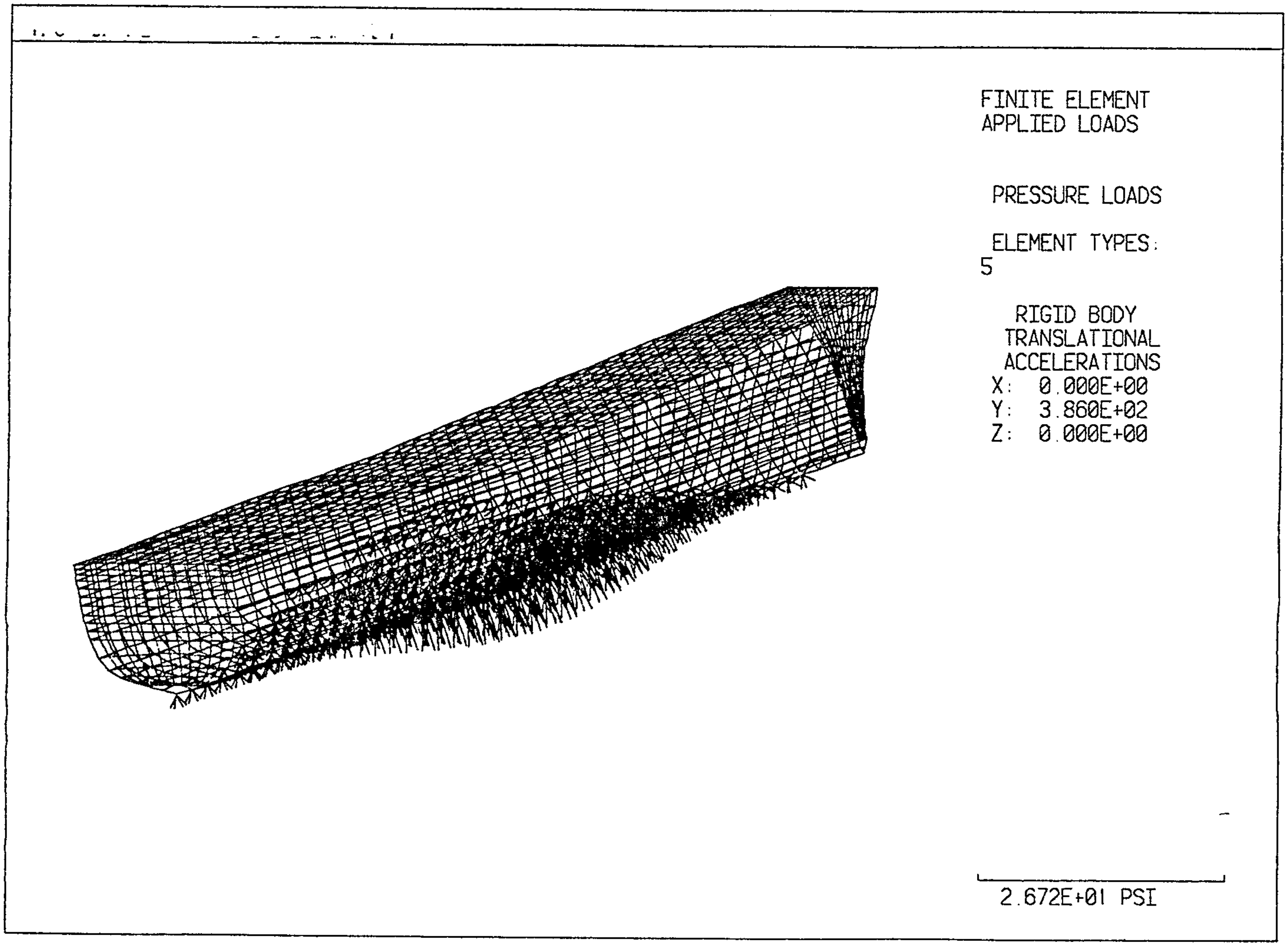


Figure 6.19: Balance-On-A-Wave Pressure Load On The Hull

Chapter 7

Option 3 Edit Existing Model

The models can be edited a section at a time to correct errors and to improve the connectivity of connecting panel nodes. These nodes are automatically equivalenced, when the finite element models are generated, unless the distance between them exceeds the allowable tolerance. The editing option also allows for inspection for duplicate beams at adjoining panels which, if found, can be removed. Connectivity between finite element models of the sections can be improved in preparation for assembly into a single large model by the use of option 15 in the editing menu.

7.1 Editing Options

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
 2 = GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
```

```
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = STOP
3

ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 30. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
2
READING FILE FRAME.D02
```

7.1.1 Option 1 Checking Title

The editing options are demonstrated in sequence.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL OR VERTICAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION    2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION    2
1

BOW OF QUEST AT BODYPLAN LINES 7 10               SECTION  2
ENTER CORRECT TITLE OR C TO CONTINUE
C
```

7.1.2 Option 2 Checking Panel Coordinates

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION   2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION   2
2
PANEL NO   1
NO      X        Y        Z
  1   114.670   460.030     0.000
  2   110.020   446.180     0.000
  3   103.830   430.020     0.000
  4    96.340   415.400     0.000
  5   108.450   411.400    47.940
  6   123.450   406.170    96.020
  7   133.560   402.890   143.960
  8   137.130   415.400   143.960
  9   140.230   426.940   143.960
 10   143.320   440.790   143.960
 11   137.900   445.410    96.020
 12   124.220   454.640    47.940
TO CORRECT DATA ENTER LINE NUMBER AND CORRECT DATA
IF DATA CORRECT ENTER C
C
```

```
PANEL NO    2
NO      X         Y         Z
 13     -0.210   416.170     0.000
 14     33.610   416.170     0.000
 15     65.100   416.170     0.000
 16     96.080   413.860     0.000
 17    108.470   411.560    47.940
 18    123.430   406.000    96.020
 19    133.830   402.890   143.960
 20     99.700   402.320   143.960
 21     52.450   402.320   143.960
 22      0.000   402.320   143.960
 23      0.000   406.940    96.020
 24      0.000   411.560    47.940
TO CORRECT DATA ENTER LINE NUMBER AND CORRECT DATA
IF DATA CORRECT ENTER C
C
```

All the panel coordinates in the section are displayed sequentially in this manner.

7.1.3 Option 3 Modelling Options

The modelling options are described in Figure 5.7 in Chapter 5.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION   2
```

```
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION    2
3


PANEL    MODEL OPTION MOPT
   1              2
   2              2
   3              2
   4              2
   5              2
   6              2
   7              2
   8              2
TO CORRECT DATA ENTER LINE NUMBER AND CORRECT DATA
IF DATA CORRECT ENTER C
C
```

7.1.4 Option 4 Frames or Longitudinal Plates

Currently SHPHUL only allows the number of tranverse frames for each section to be specified once. In the absence of frames the number of longitudinal plates must be specified.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION    2
13 = EDIT DUPLICATE BEAMS
```

```
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION    2
4
FORWARD AND AFT FRAME LOCATIONS      0.000    143.961
ENTER CORRECT VALUES OR C TO CONTINUE
C

NUMBER OF BEAMS AND ELEMENTS BETWEEN THE BEAMS
 5   TRANVERSE FRAMES    1 ELEMENTS BETWEEN BEAMS

ENTER CORRECT VALUES OR C TO CONTINUE
C
```

7.1.5 Option 5 Frame or Plate Spacing

The frames or longitudinal plates may be evenly spaced. If unevenly spaced the spacing fractions must be given starting at 0 and ending with 1.0.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION    2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION    2
5
```

```
 FRAMES SPACING FRACTIONS

  EVENLY SPACED

ENTER C IF SPACING CORRECT
OR THE CORRECT SPACING FOR 5 FRAMES OR PLATES
OR E IF EVENLY SPACED
C
```

7.1.6 Option 6 Number of Longitudinal Beams or Tranverse Plates

The number of longitudinal side or deck beams, orthoginal to the frames or bulkhead beams, must be present. In their absence the equivalent number of tranverse plates will be shown instead.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION   2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION   2
6

PANEL  NO OF TRANVERSE     PLATES      SIDE
 1            5
ENTER CORRECT VALUES OR C TO CONTINUE
C
```

```
PANEL  NO OF TRANVERSE     PLATES      DECK
 2           5
ENTER CORRECT VALUES OR C TO CONTINUE
C

PANEL  NO OF TRANVERSE     PLATES      SIDE
 3           5
ENTER CORRECT VALUES OR C TO CONTINUE
C

PANEL  NO OF TRANVERSE     PLATES      DECK
 4           5
ENTER CORRECT VALUES OR C TO CONTINUE
C

PANEL  NO OF TRANVERSE   PLATES      SIDE
 5           7
ENTER CORRECT VALUES OR C TO CONTINUE
C

PANEL  NO OF TRANVERSE     PLATES      SIDE
 6           5
ENTER CORRECT VALUES OR C TO CONTINUE
C

PANEL  NO OF TRANVERSE     PLATES      SIDE
 7           5
ENTER CORRECT VALUES OR C TO CONTINUE
C

ENTER
0 TO CONTINUE
1 TO REVIEW EDITING
0
```

7.1.7 Option 7 Beam or Plate Spacing

The beam or plate spacing for the option 6 beams is displayed for checking.

```
CHOOSE EDITING OPTION
```

```
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION  32
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION  32
7
PLATES SPACING FRACTIONS ENTER PANEL NUMBER AND CORRECT DATA
PANEL     SPACING    PART
  1  EVENLY SPACED        SIDE
C
PLATES SPACING FRACTIONS ENTER PANEL NUMBER AND CORRECT DATA
PANEL     SPACING    PART
  2  EVENLY SPACED        DECK
C

PLATES SPACING FRACTIONS ENTER PANEL NUMBER AND CORRECT DATA
PANEL     SPACING    PART
  3  EVENLY SPACED        SIDE
C

PLATES SPACING FRACTIONS ENTER PANEL NUMBER AND CORRECT DATA
PANEL     SPACING    PART
  4  EVENLY SPACED        DECK
C

PLATES SPACING FRACTIONS ENTER PANEL NUMBER AND CORRECT DATA
PANEL     SPACING    PART
  5  EVENLY SPACED        SIDE
```

```
C
PLATES SPACING FRACTIONS ENTER PANEL NUMBER AND CORRECT DATA
PANEL      SPACING     PART
  6  EVENLY SPACED         SIDE
C

PLATES SPACING FRACTIONS ENTER PANEL NUMBER AND CORRECT DATA
PANEL      SPACING     PART
  7  EVENLY SPACED         SIDE
C

PLATES SPACING FRACTIONS ENTER PANEL NUMBER AND CORRECT DATA
PANEL      SPACING     PART
  8  EVENLY SPACED         SIDE
C

ENTER
0 TO CONTINUE
1 TO REVIEW EDITING
0
```

7.1.8 Option 8 Frame and Beam Sizes

Frame and beam sizes are displayed for checking. They will also represent the beam sizes if a bulkhead is being checked.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
```

```
12 = VIEW PANELS FOR SECTION  32
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION  32
8

PANEL  LINE  BEAM NO    BEAM TYPE
  1     1       2          6X3.5A        FRAME
  2     1       2          6X3.5A        FRAME
  3     1       2          6X3.5A        FRAME
  4     1       2          6X3.5A        FRAME
  5     1       2          6X3.5A        FRAME
  6     1       2          6X3.5A        FRAME
  7     1       2          6X3.5A        FRAME
TO CORRECT DATA ENTER PANEL NUMBER LINE NUMBER
AND BEAM NUMBER
C
```

7.1.9 Option 9 Panel Thickness

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION   2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION   2
9
```

```
PANEL   PLATE THICKNESS
  1          0.313     SIDE
  2          0.290     DECK
  3          0.500     SIDE
  4          0.290     DECK
  5          0.500     SIDE
  6          0.500     SIDE
  7          0.500     SIDE
TO CORRECT DATA ENTER LINE NUMBER AND CORRECT DATA
IF DATA CORRECT ENTER C
C
```

7.1.10 Option 10 Panel Materials

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION    2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION    2
10

YOUNGS MODULUS  DENSITY
1 30000000.000   0.734E-03
2 30000000.000   0.734E-03
3 30000000.000   0.734E-03
4 30000000.000   0.734E-03
```

```
5 30000000.000    0.734E-03
6 30000000.000    0.734E-03
7 30000000.000    0.734E-03

TO CORRECT DATA ENTER LINE NUMBER AND CORRECT DATA
IF DATA CORRECT ENTER C
C
```

7.1.11 Option 11 Edit Panel Coordinates With Cursor

The panels and there node numbers are displayed. The nodes can be relocated to correct errors and to improve the equivalencing of the adjacent panel nodes.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION    2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION    2
11

ENTER THE STATION NUMBERS OF THE FIRST AND LAST
SECTIONS OF THE BODY PLAN TO BE PLOTTED
7 10
```

The panels superimposed on the bodyplan curves from 7 to 10 for editing node location are shown in Figure 7.1.

```
ENTER
NODE NUMBER TO CHANGE LOCATION WITH CURSER
      W TO WINDOW PANEL
      R REPLOT PANELS
      E END EDIT OPTION
W
```

The previous section coordinates are read for plotting the nodes connecting section 1 and 2 and the QUESM.DAT file is read for plotting the bodyplan curves. The W entry indicates windowing of the plot. The windowed region is shown in Figure 7.2.

```
ENTER
NODE NUMBER TO CHANGE LOCATION WITH CURSER
      W TO WINDOW PANEL
      R REPLOT PANELS
      E END EDIT OPTION
61
```

The number 61 is to be moved to a better location as shown in the enlarged view in Figure 7.3.

```
ENTER
NODE NUMBER TO CHANGE LOCATION WITH CURSER
      W TO WINDOW PANEL
      R REPLOT PANELS
      E END EDIT OPTION
E
```

The plotting for correction of the node placement is ended with the E entry.

7.1.12 Option 12 View Assembled Panels

The assembly of panels can be viewed for better inspection of the nodal equivalencing.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
```

```
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION   2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION   2
12
```

This option allows the section panels to be rotated to obtain a better assessment of the panel node numbering and to show any undesirable panel distortion in the assembly. No editing of the nodes can be done with this option. Coordinates can be obtained with the cursor when the rotations are 0 0 0.

```
ENTER THE STATION NUMBERS OF THE FIRST AND LAST SECTIONS OF
THE BODY PLAN TO BE PLOTTED
7 10

ENTER THE ANGLES OF ROTATIONS ABOUT THE X Y Z AXES
TO DISPLAY THE MODEL
20 20 20

0 = PLOT PANELS CONTINUOUSLY
1 = PLOT PANEL BY PANEL
0
```

The plotted assembly of the section panels is shown in Figure 7.4

```
ENTER
W TO WINDOW PANEL
C TO OBTAIN COORDS
```

```
R TO REPLOT PANELS
E TO END PLOTTING
E
```

7.1.13 Option 13 Edit Duplicate Beams

Although SHPHUL attempts to eliminate duplicate beams at connecting panel edges editing to remove or add beams is sometimes required.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION    2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION    2
13

 The beams of the section panels can be viewed graphically using Option 2
of the main option list.

    SIDE DUPLICATE BEAMS
        PANEL EDGE
PANEL NO TRANVERSE FRAMES      BEAMS
  1            1                2
ENTER C CONTINUE
      E ERROR MAKE CHANGE
      H HELP
H
```

```
DUPLICATE BEAM FLAGS
IDF=1 REMOVES DUPLICATE FRAME BEAM FORWARD
IDF=2 REMOVES DUPLICATE FRAME BEAM AFT
IDB=1 REMOVES DUPLICATE PANEL SIDE BEAM UP
IDB=2 REMOVES DUPLICATE PANEL SIDE BEAM DOWN
IDF,IDB=3 REMOVES DUPLICATE BEAMS ON BOTH EDGES
IDF,IDB=0 BEAMS ARE LEFT ON BOTH EDGES
PRESS RETURN
```

Duplicate beams will occur along shared edges when sections are assembled. SHPHUL attempts to eliminate this problem, however some situations are too complex to guarantee that beams in some locations have not been duplicated. The beams can be inspected by plotting each section using option 2 of the main option list or option 15 of the editing option list. Changes can then be made through this editing option. IDF refers to the frames or deck transverse beams and longitudinal bulkhead vertical beams. In accordance with the convention shown above IDF can add or remove forward or aft beams from these parts. In a similar manner IDB refers to longitudinal beams on sides and decks such as the top or bottom beam on a side panel or the inner or outer beam on a deck. In the case of tranverse bulkheads. IDF refers to the top and bottom beams and IDB refers to the beams at the sides.

```
    SIDE DUPLICATE BEAMS
        PANEL EDGE
PANEL NO TRANVERSE FRAMES      BEAMS
  1           1                  2
ENTER C CONTINUE
      E ERROR MAKE CHANGE
      H HELP

    DECK DUPLICATE BEAMS
        PANEL EDGE
PANEL NO TRANVERSE FRAMES      BEAMS
  2           1                  1
ENTER C CONTINUE
      E ERROR MAKE CHANGE
      H HELP
C
```

```
    SIDE DUPLICATE BEAMS
        PANEL EDGE
PANEL NO TRANVERSE FRAMES      BEAMS
  3            1                 1
ENTER C CONTINUE
      E ERROR MAKE CHANGE
      H HELP
C
    DECK DUPLICATE BEAMS
        PANEL EDGE
PANEL NO TRANVERSE FRAMES      BEAMS
  4            1                 1
ENTER C CONTINUE
      E ERROR MAKE CHANGE
      H HELP
C
    SIDE DUPLICATE BEAMS
        PANEL EDGE
PANEL NO TRANVERSE FRAMES      BEAMS
  5            1                 1
ENTER C CONTINUE
      E ERROR MAKE CHANGE
      H HELP
C
    SIDE DUPLICATE BEAMS
        PANEL EDGE
PANEL NO TRANVERSE FRAMES      BEAMS
  6            1                 1
ENTER C CONTINUE
      E ERROR MAKE CHANGE
      H HELP
C
    SIDE DUPLICATE BEAMS
        PANEL EDGE
PANEL NO TRANVERSE FRAMES      BEAMS
  7            1                 1
ENTER C CONTINUE
      E ERROR MAKE CHANGE
      H HELP
```

```
C

ENTER
0 TO CONTINUE
1 TO REVIEW EDITING
0
```

7.1.14 Option 14 Identify Sides Decks and Bulkheads

The identification of panel parts is necessary for applying loads and fluid elements to the hull. Each panel will be displayed for identification then erased. They can be listed previously with option 9 for checking .

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION  32
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION  32
14

TO IDENTIFY HULL PARTS ENTER AFTER EACH PANEL DISPLAY
S = SIDE
D = DECK
B = BULK
L = LONGITUDINAL BULKHD
T = STERN OR BOW BULKHD
ENTER C TO CONTINUE
```

C

The panels are displayed sequentially for identification in the same manner as in the completion of the panel generation in Option 1 of the main option list.

7.1.15 Option 15 Check Adjacent Geometry Files For Node Equivalencing

This option was design primarily to check on the equivalencing of adjacent sections which have been converted to VAST geometry file form, using option 12 from the main option list. It can also be used to plot the section geometry files to check the plates and beams separately.

```
CHOOSE EDITING OPTION
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION  2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION  2
15

VAST GEOMETRY FILE SHP02.GOM EXIST
0 CONTINUE AND PLOT FILE
1 RELOCATE NOES
2 RETURN TO EDIT MENU
0
```

Any VAST geometry file can be plotted at this stage provided it has a basic geometry file such as FRAME.D02 in existence.

```
ENTER
0 TO LABEL NODES WITH CURSOR
1 TO PRINT NODE NUMBERS
0

ENTER
0 TO PLOT PLOTES
1 TO PLOT BEAMS
1

ENTER THE ANGLES OF ROTATION ABOUT X Y Z AXES
TO DISPLAY MODEL
10 10 10

AFTER PLOTTING ENTER
W TO WINDOW
E TO END
L TO LABEL NODES
ENTER 0 TO CONTINUE
0
```

The resulting plot of the beams is shown in Figure 7.5. The plot shows the beams that have been removed to avoid duplication when the section is joined the next aft section.

```
L
```

The entry of the character L brings up the cursor with which to identify node numbers. It must be entered each time a node number is required. The entry of E erases the plot and displays the following prompt.

```
VAST GEOMETRY FILE SHP02.GOM EXIST
0 CONTINUE AND PLOT FILE
1 RELOCATE NOES
2 RETURN TO EDIT MENU
1
```

This option will allow adjoining nodes between sections to be equivalenced with the cursor if they appear not to match well.

```
ENTER THE NUMBERS OF THE TWO ADJACENT SECTIONS
83 84
```

The program is not constricted to the the section initially identified. Any two adjacent sections which have VAST finite element geometry files can be checked for mismatching nodes.

```
THE FOLLOWING SECTIONS HAVE BEEN FOUND SHP83.GOM
SHP84.GOM
ENTER X Y Z ROTATIONS FOR VIEWING
45 45 45
```

The two sections are plotted as shown in Figure 7.6. One is plotted with full lines the other with dotted lines. The full line nodal coordinates are converted to the dotted line nodal values. The first section given will conform to the second section. If 84 is given first it will conform to 83. This is especially useful in matching bulkheads to hull sides and decks where it is more acceptable to distort the bulkhead stiffeners to conform to the hull.

```
ENTER
L TO LABEL AND RELOCATE NODES
W TO WINDOW
E TO END
W
```

A portion of the junction where the sections meet was windowed for easier viewing of a mismatch between nodes. Figure 7.7 shows the enlarged region and the location and fix of the mismatching nodes.

```
VAST GEOMETRY FILE SHP83.GOM EXIST
0 CONTINUE AND PLOT FILE
1 RELOCATE NOES
2 RETURN TO EDIT MENU
2
```

Instead of returning to the menu the two sections could have been replotted to check the relocation and matchup of the two nodes.

```
CHOOSE EDITING OPTION
```

```
1 = TITLE
2 = PANEL COORDINATES
3 = MODELLING OPTION
4 = FRAMES OR LONGITUDINAL PLATES
5 = FRAME OR PLATE SPACING
6 = LONGITUDINAL BEAMS OR TRANVERSE PLATES
7 = BEAM OR PLATE SPACING
8 = FRAME AND BEAM SIZES
9 = PANEL THICKNESS
10= PANEL MATERIALS
11 = EDIT PANEL COORDINATES WITH CURSOR
12 = VIEW PANELS FOR SECTION  2
13 = EDIT DUPLICATE BEAMS
14 = IDENTIFY SIDE,DECKS AND BULKHEADS
15 = CHECK ADJACENT VAST GEOMETRY FILES FOR NODE EQUIVALENCING
16 = END OF EDITING SECTION  2
16
```

Option 16 returns the main Menu.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
```

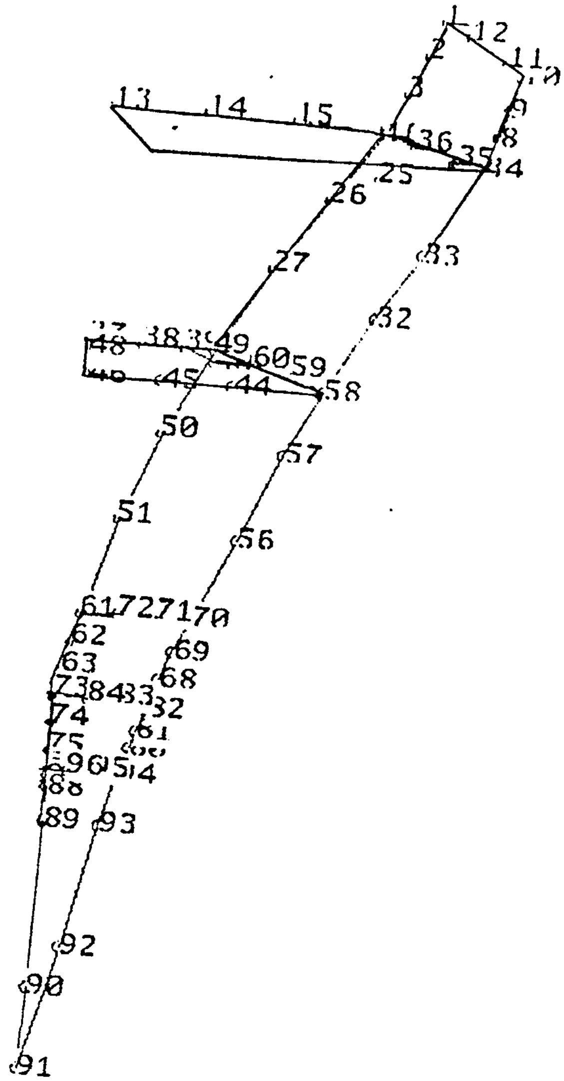


Figure 7.1: Display Of Panels For Editing Panel Node Location

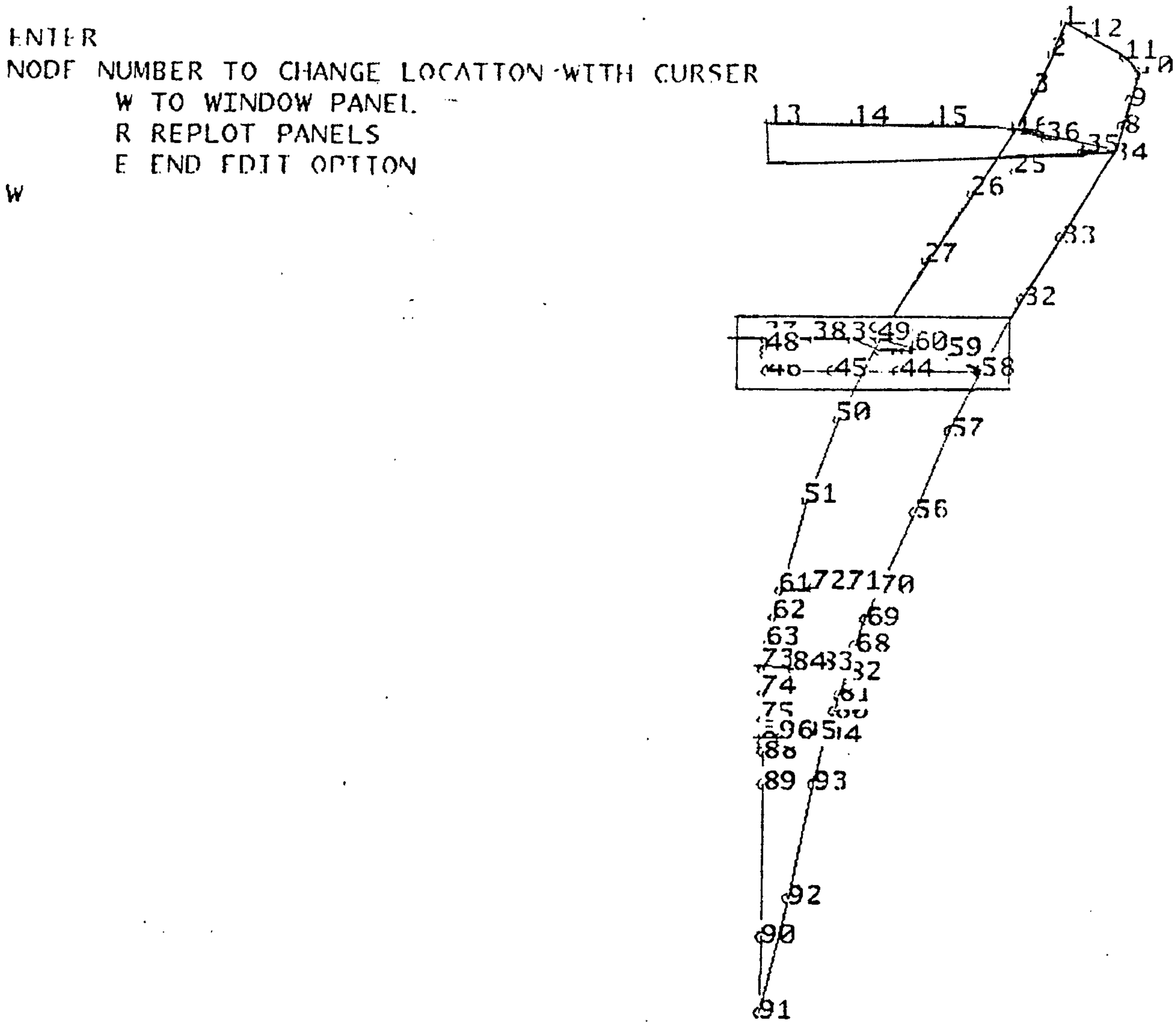


Figure 7.2: The Use Of A Window To Enlarge The Region For Node Editing

```
43
ENTFR
NODE NUMBER TO CHANGE LOCATION WTTH CURSFR
      W TO WINDOW PANEI
      R REPLOT PANELS
      E END FDIT OPTTON
40
```

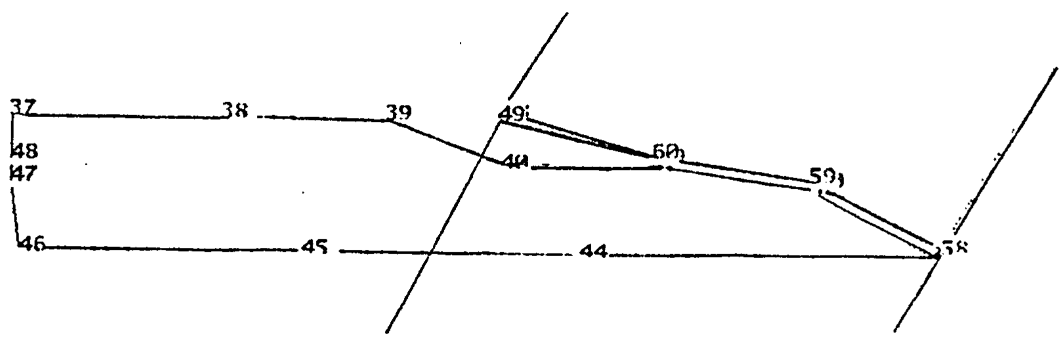


Figure 7.3: Relocation Of A Node In An Enlarged Area Of The Section

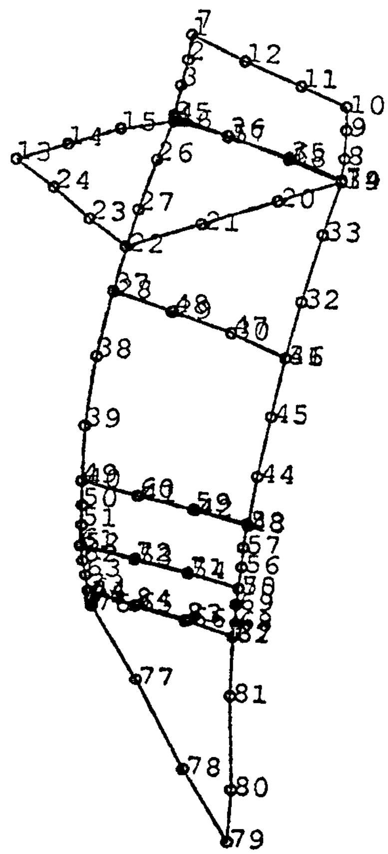


Figure 7.4: The Section Panels Rotated With Option 12 For Inspection Of Numbering

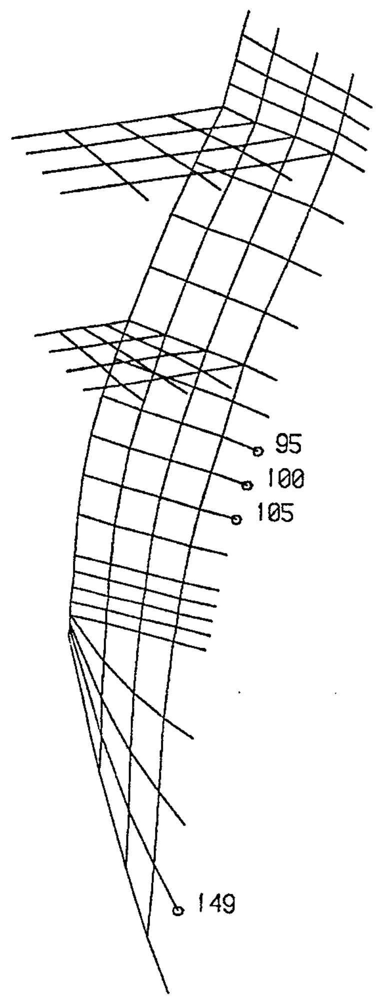


Figure 7.5: A Plot Of The Section Beams With Node Numbers Identified With The Cursor

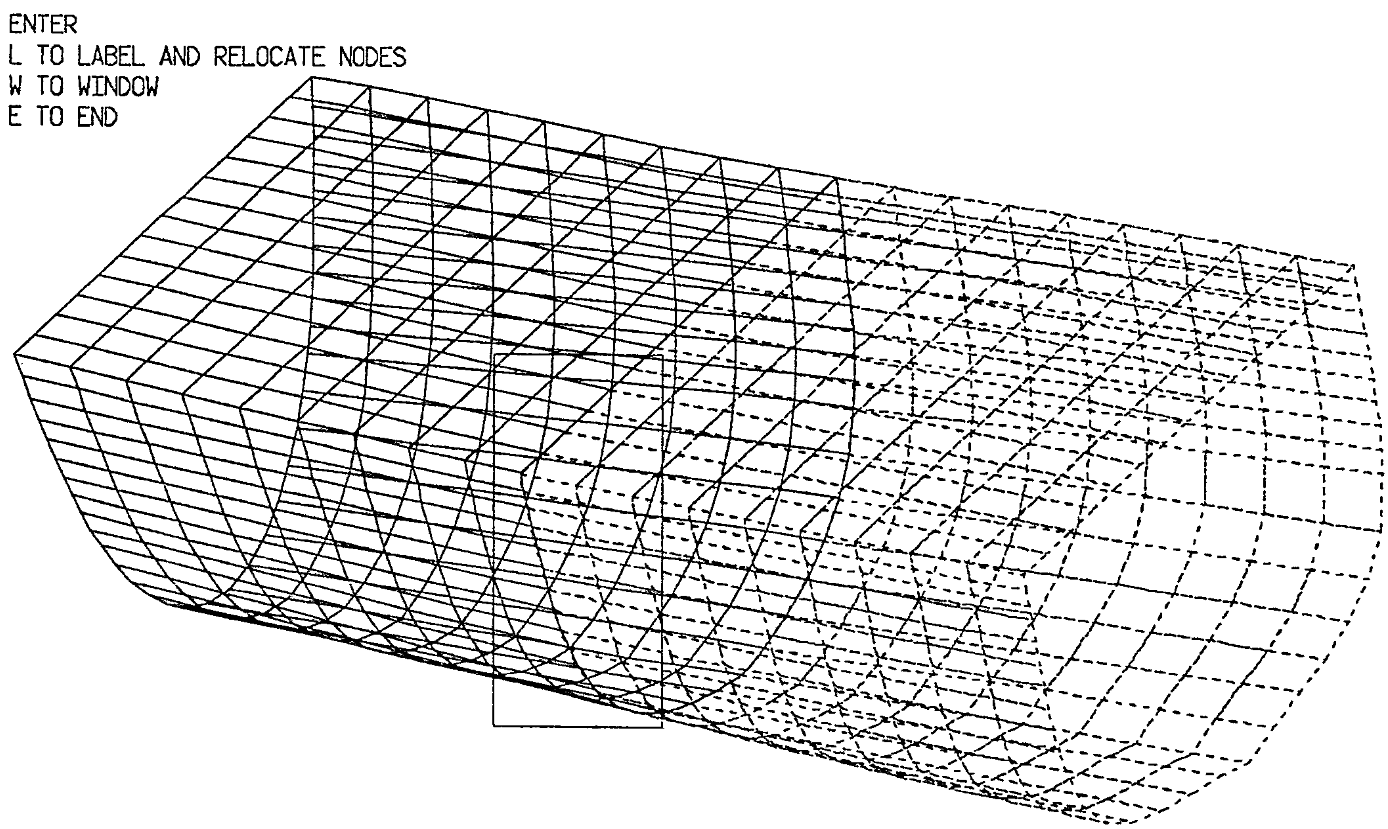


Figure 7.6: A Plot Of Adjacent Sections With A Window Of An Area Of Mismatched Nodes

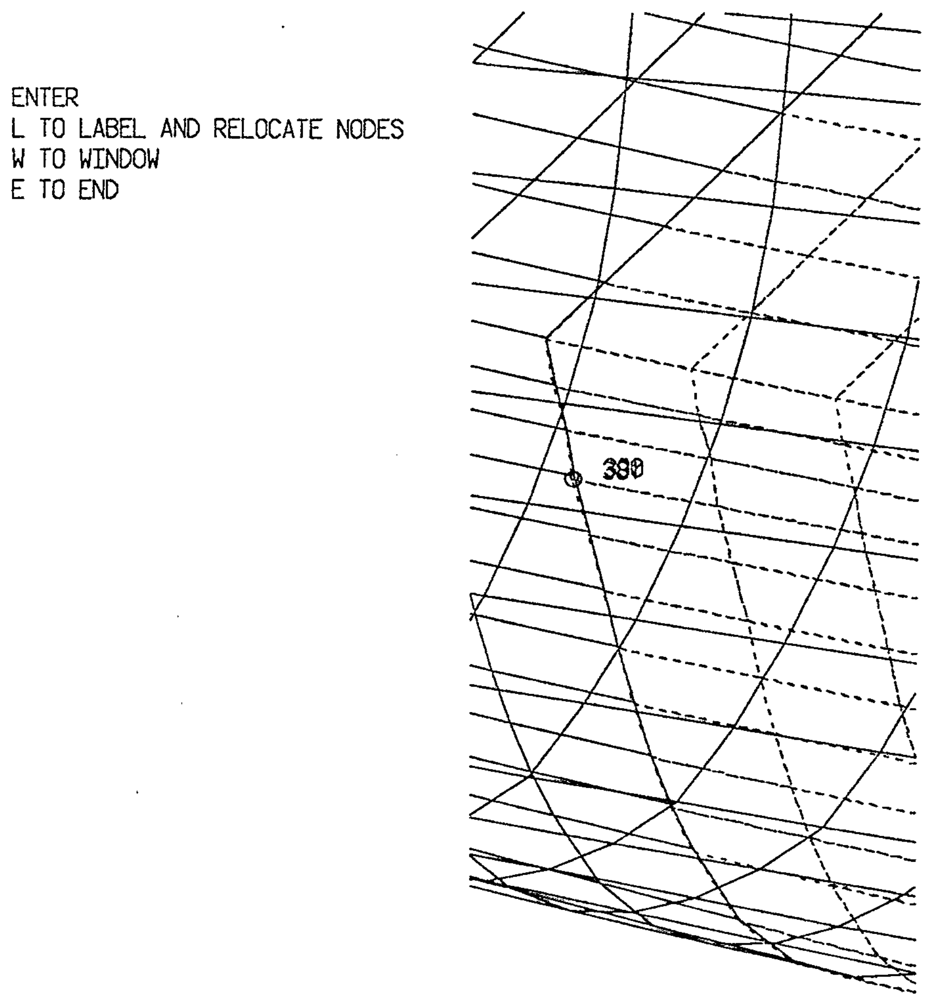


Figure 7.7: The Correction Of The Mismatch Between Nodes With The Cursor

Chapter 8

Option 4 Add To Existing Model

At any time additional panels may be added to existing sections. It is often convenient to add longitudinal bulkheads that fall along the center line after the section model has been mirror imaged. In this way the duplication of the center line bulkhead by the mirroring process is avoided. It also allows later modifications to the structure to be accounted for. The following example shows the procedure for adding a longitudinal bulkhead to a full crossection model. The crossection model prior to the addition of the bulkhead is shown in Figure 8.1

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
```

```
4
A COMPLETE DATA FILE EXSISTS
ENTER C TO CONTINUE AND USE THE DATA
      E TO EXAMINE AND EDIT THE DATA
C

ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 90. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
7

READING FILE FRAME.D07
READ FILE FRAME.D06
```

SHPHUL reads the frame files for previous panel reference nodes and current panel data.

```
ENTER THE STATION NUMBERS OF THE FIRST AND LAST SECTIONS OF
THE BODY PLAN TO BE PLOTTED
19 22
```

The existing panels are plotted with the required body plan curves, as shown in Figure 8.2, for adding additional panels. Each large X is the location of the connecting nodes of the previous section. In this case a longitudinal bulkhead is added to the full section at the centerline. The entry of S at the end of the bulkhead panel generation results in the following prompt.

```
SHIP NAME CNAV QUEST

IDENTIFY HULL PARTS
1 = YES
0 = NO
1

TO IDENTIFY HULL PARTS ENTER AFTER EACH PANEL DISPLAY
S = SIDE
```

```
D = DECK
B = BULKHD
L = LONGITUDINAL BULKHD
T = STERN OR BOW BULKHD
ENTER C TO CONTINUE
```

All of the panels of the crossection including the new one are displayed one at a time for identification.

```
17 PANELS IN SECTION=  7
 PANEL GRIDING
1 = DECKS AND HULL SHELL
2 = LONGITUINAL BULKHEADS
3 = TRANVERSE BULKHEADS
4 = STOP
2

ENTER THE NUMBER OF VERTICAL BEAMS IN PANEL 17
11

ENTER THE NUMBER OF ELEMENTS BETWEEN BEAMS

ARE BEAMS  EVENLY SPACED
 0 = YES   1 = NO
0

*** PANEL  17 ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL 17 LBULK
ENTER S TO STOP DATA ENTRY
1

CHOOSE BEAM SIZE FROM FOLLOWING BY ENTERING LINE NUMBER
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
2
```

```
** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL 17 LBULK
0
```

A zero entry results in a request for the number of vertical plates as there are no longitudinal beams used in this case.

```
ENTER THE NUMBER OF VERTICAL PLATES IN BULKHD PANEL 17
8

ARE PLATES EVENLY SPACED
 0 = YES    1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
30000000

ENTER POISSONS RATIO
.3

ENTER DENSITY
.000734

ENTER THE PLATE THICKNESS FOR PANEL 17 LBULK
.29

WRITING FILE FRAME.D07
```

The frame file with the new panel is written.

```
PROCESSING SECTION  7

PLOT SECTION MODEL  7
 0 = YES
 1 = NO
0

CHOOSE THE PLANE IN WHICH DECKS ARE TO BE DISPLAYED
```

```
1 =  LENGTH OF SHIP ALONG X AXIS
2 =  LENGTH OF SHIP ALONG Z AXIS
2

ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10

0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
0

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The gridded section model with the newly added longitudinal bulkhead is shown in Figure 8.3.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
4
```

The option to display the normals to the panels to indicate which side the beam eccentricities are applied was chosen.

```
ENTER ANGLES OF ROTATION ABOUT XYZ AXES TO DISPLAY MODEL
10 10 10
ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SIZE SCREEN
10

0 = CONTINUOUSLY PLOT
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The plot of normals to the panels as shown in Figure 8.4 indicates on which side of the panels the beams are placed.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
8

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
```

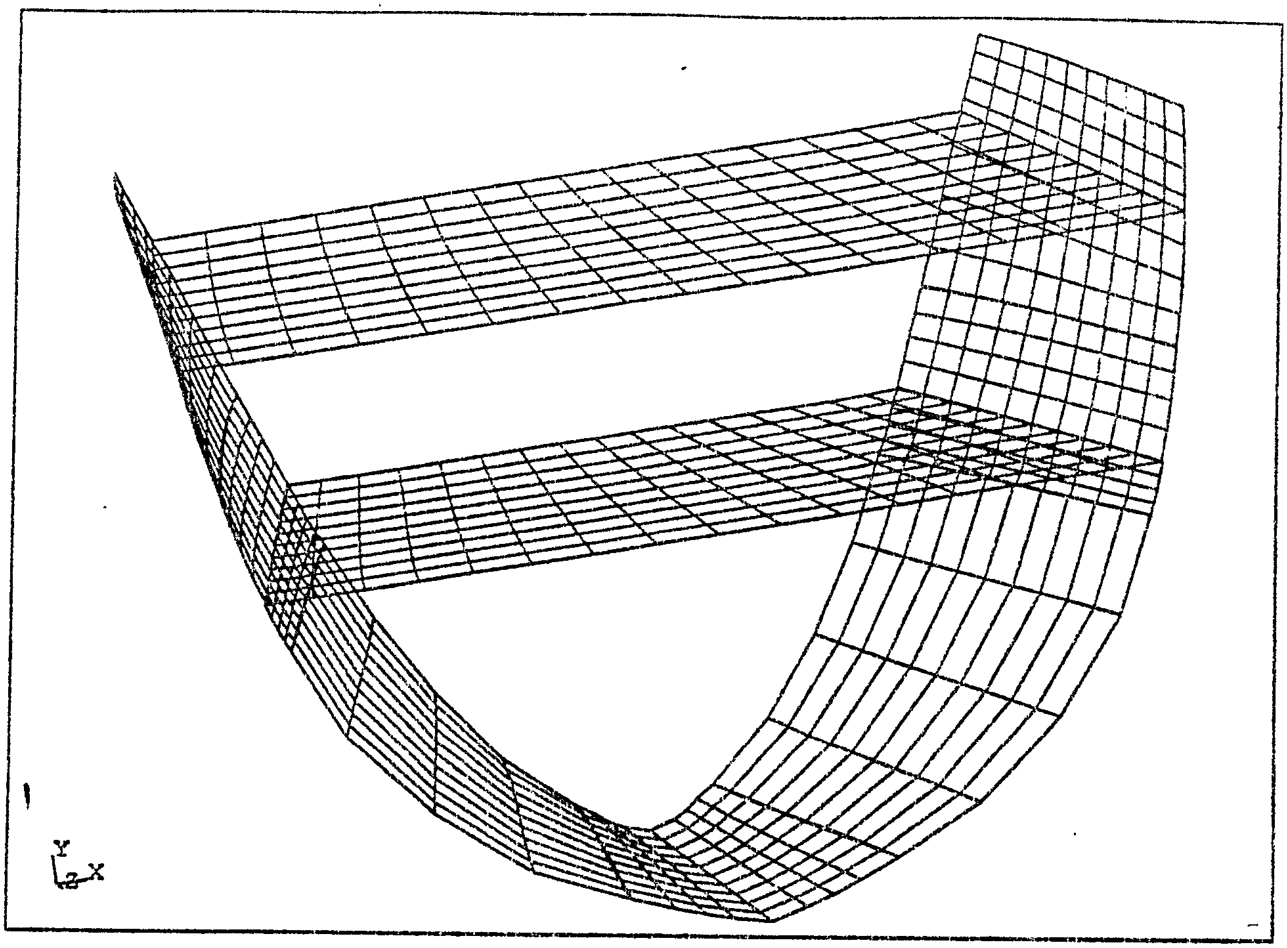


Figure 8.1: Hull Section Before Addition Of Longitudinal Bulkhead

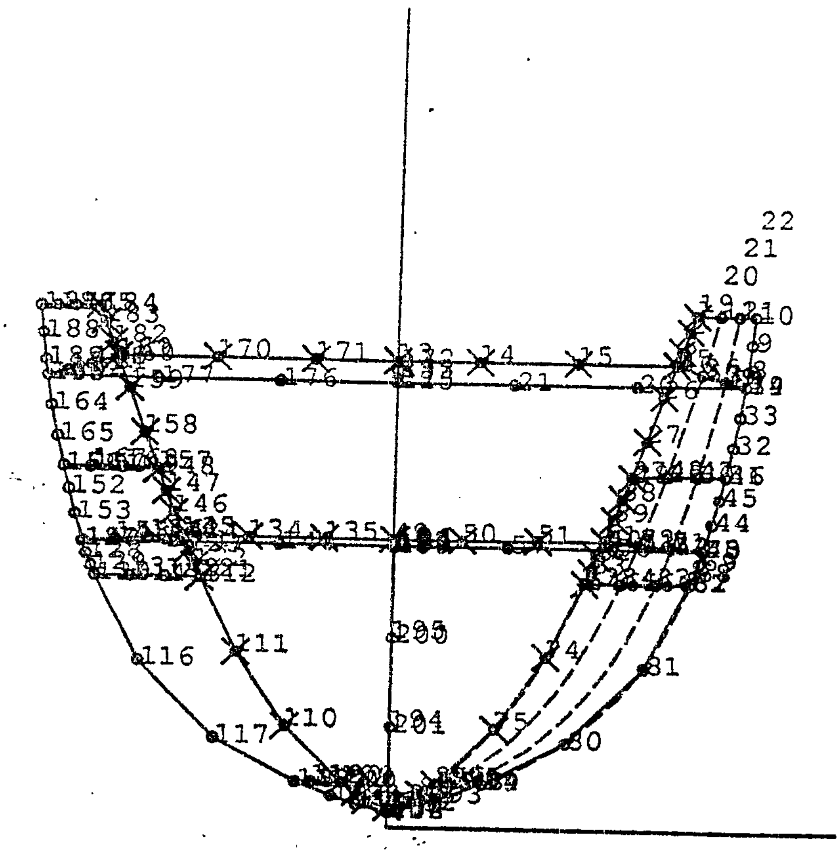


Figure 8.2: Display Of Panels, Bodyplan Curves And Connecting Nodes For Generating The Bulkhead

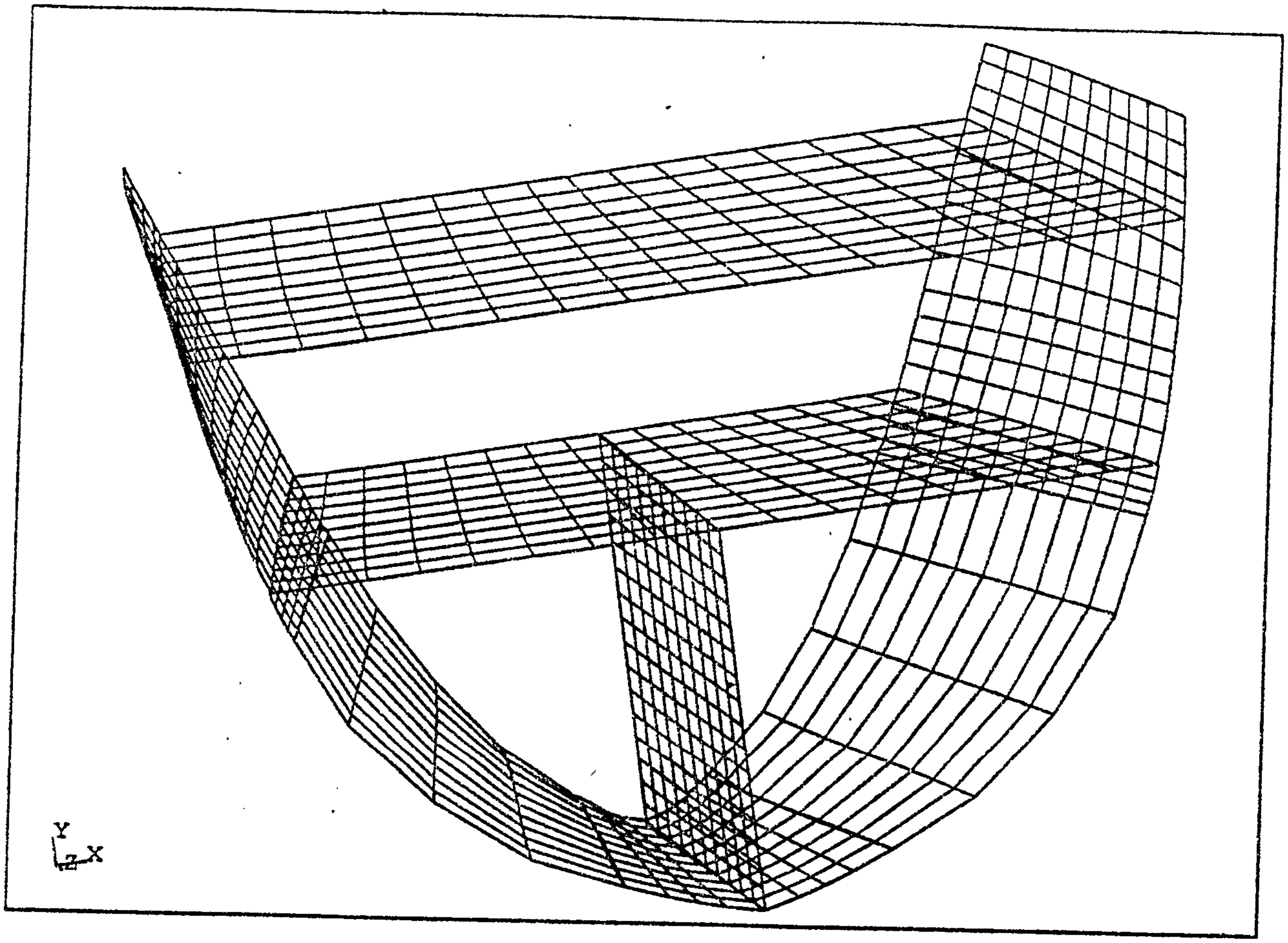


Figure 8.3: Section Model Showing The Generated And Grided Longitudinal Bulkhead

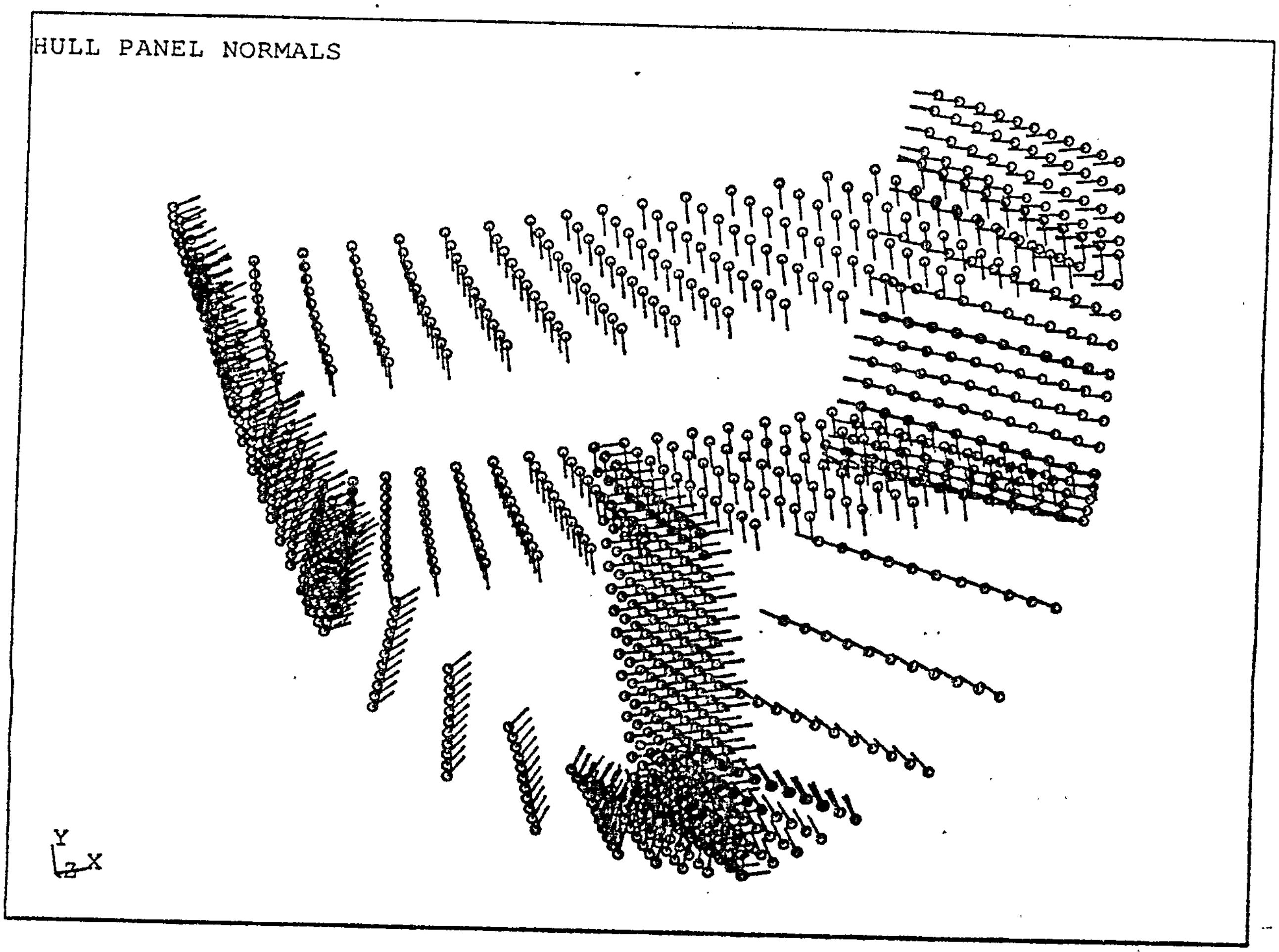


Figure 8.4: Plot Of Normals To The Panels To Show The Sides The Beams Are On

Chapter 9

Option 5 Examine Or Edit Beam Data

At any stage of the modelling the beam data can be examined and edited. Beams can be added and their specifications changed or corrected.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
5
SHIP NAME QUEST
```

```
BEAM SIZES
  1    6X1PL
  2    6X3.5A
  3    4X.5PL
  4    6X3.5X.3
  5    4X3A
  6    12X6T

TO EXAMINE ALL BEAMS ENTER 0
TO EXAMINE A SPECIFIC BEAM ENTER THE BEAM NUMBER
TO ADD A BEAM ENTER -1
TO CHANGE DATA TITLE -3
TO EXIT ENTER -4
-3
ENTER SHIP NAME FOR BEAM DATA
CNAV QUEST

SHIP NAME CNAV QUEST
BEAM SIZES
  1    6X1PL
  2    6X3.5A
  3    4X.5PL
  4    6X3.5X.3
  5    4X3A
  6    12X6T

TO EXAMINE ALL BEAMS ENTER 0
TO EXAMINE A SPECIFIC BEAM ENTER THE BEAM NUMBER
TO ADD A BEAM ENTER -1
TO CHANGE DATA TITLE -3
TO EXIT ENTER -4
2
BEAM TYPE   6X3.5A
ENTER CORRECT VALUES OR C TO CONTINUE
C

CROSSECTION AREA   4.16
C
TORSIONAL MOMENT OF INERTIA  0.330
```

```
C
MOMENTS OF INERTIA ABOUT LOCAL Y AND Z   3.97      15.4
C
PRODUCT OF INERTIA  0.000E+00
C
LOCAL YZ COORDINATES OF SHEAR CENTER   1.84      2.45
C
SHEAR FORM FACTORS ABOUT Y AND Z   1.00      1.00
C
Y COORDINATES OF STRESS PTS  0.820     0.820     -5.18     -5.18
C
Z COORDINATES OF STRESS PTS  -3.93    -0.430     -3.93     -3.47
C
BEAM ECCENTRICITIES   3.93     0.000E+00
C

BEAM SIZES
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T

TO EXAMINE ALL BEAMS ENTER 0
TO EXAMINE A SPECIFIC BEAM ENTER THE BEAM NUMBER
TO ADD A BEAM ENTER -1
TO CHANGE DATA TITLE -3
TO EXIT ENTER -4
-1

ENTER BEAM TYPE,SIZE AND MASS (eg: WT 305 X 70)
FOR BEAM   7
WT 9 X 59.5
ENTER
0 = BEAM PROPERTIES SPECIFIED BY USER
1 = BEAM PROPERTIES CALCULATED FROM BEAM DIMENSIONS
1
```

```
ENTER
0 = NO SHEAR DEFORMATION
1 = SHEAR DEFORMATION EXPECTED
0

CHOOSE BEAM TYPE
5 = I SECTION
7 = ANGLE
8 = CHANNEL
9 = Z SECTION
10 = T SECTION
10

ENTER
FLANGE WIDTH
DEPTH OF SECTION
AVERAGE FLANGE THICKNESS
AVERAGE WEB THICKNESS
11.265 9.485 1.060 .655

ENTER
THE Y COORDINATES FROM THE DATUM (REF. VAST USER MANUAL
PAGE C2-E13.12 FOR FOUR STRESS PTS ON THE SECTION.
DEFAULT VALUES ARE 1.0
2.03 2.03 -7.455 -7.455

ENTER THE FOUR Z COORDINATES FROM THE DATUM
5.6 -5.6 .327 -.327

ENTER BEAM ECCENTRICITIES (THE LOCAL Y Z DISTANCES THE
CENTROID IS OFFSET FROM THE LINE THROUGH THE NODES)
Y OFFSET PLUS HALF PLATE THICKNESS (P C2-E3.9 VAST USER MANUAL
7.60  0.0


SHIP NAME CNAV QUEST
BEAM SIZES
  1   6X1PL
  2   6X3.5A
```

```
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
  7   WT 9 X 59.5
TO EXAMINE ALL BEAMS ENTER 0
TO EXAMINE A SPECIFIC BEAM ENTER THE BEAM NUMBER
TO ADD A BEAM ENTER -1
TO CHANGE DATA TITLE -3
TO EXIT ENTER -4
-4

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
FORTRAN STOP
```

Chapter 10

Option 6 Create New Model From Existing Section

The panels of an existing section can be regridded with new beams and plates or with the existing plates and beams to a finer grid.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
6
```

```
ENTER
1 TO CHANGE ALL SECTIONS TO HYBRID BEAM MODELS
2 TO CHANGE ALL SECTIONS TO SMEARED BEAM-PLATE MODELS
3 TO CHANGE BEAM GRID OF AN INDIVIDUAL SECTION
4 TO CHANGE ALL SECTIONS BACK TO GENERAL BEAM PLATE MODEL


ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 90. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
2
READING FILE FRAME.D02
 8 PANELS IN SECTION=  2

 PANEL GRIDING
1 = DECKS AND HULL SHELL
2 = LONGITUINAL BULKHEADS
3 = TRANVERSE BULKHEADS
4 = STERN OR BOW BULKHEAD
5 = STOP
1
ENTER TITLE OF SECTION TO BE MODELLED (MAX 50 CHAR)
BOW OF QUEST AT BODYPLAN STATIONS 7 TO 10

ENTER THE NUMBER OF TRANVERSE FRAMES IN PANEL  1  SIDE
8

ENTER THE NUMBER OF ELEMENTS BETWEEN FRAMES
1

ARE FRAMES EVENLY SPACED
 0 = YES   1 = NO
0

*** PANEL   1 ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  1  SIDE
ENTER S TO STOP DATA ENTRY
2
```

```
CHOOSE FRAME  1 SIZE FROM FOLLOWING BY ENTERING LINE NUMBER
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
2

** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  1  SIDE
8

ARE BEAMS EVENLY SPACED
 0 = YES   1 = NO
0

CHOOSE BEAM SIZE FROM FOLLOWING BY ENTERING LINE NUMBER
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
3
ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
30000000

ENTER POISSONS RATIO
.3

ENTER DENSITY
.000734

ENTER THE PLATE THICKNESS FOR PANEL  1  SIDE
.312

*** PANEL  2 ***
```

```
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  2  DECK
ENTER S TO STOP DATA ENTRY
1

CHOOSE TRANVERS BEAM SIZE FOR PANEL  2
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
 2
** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  2  DECK
0
ENTER
THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  2  DECK
8

ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  2  DECK
.29

***  PANEL   3  ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  3  SIDE
ENTER S TO STOP DATA ENTRY
2

CHOOSE TRANVERS BEAM SIZE FOR PANEL  3
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
```

```
  5   4X3A
  6   12X6T
 2

** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  3  SIDE
8

ARE BEAMS EVENLY SPACED
 0 = YES   1 = NO
0

CHOOSE LONGITDL BEAM SIZE FOR PANEL  3
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
 3

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  3  SIDE
.3125

***  PANEL   4  ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  4  DECK
ENTER S TO STOP DATA ENTRY
1

CHOOSE TRANVERS BEAM SIZE FOR PANEL  4
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
```

```
 2

** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  4  DECK
8

ARE BEAMS EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  4  DECK
.29

***  PANEL   5  ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  5  SIDE
ENTER S TO STOP DATA ENTRY
2
CHOOSE TRANVERS BEAM SIZE FOR PANEL 5
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
2
** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  5  SIDE
0
ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  5  SIDE
8
ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S
```

```
ENTER THE PLATE THICKNESS FOR PANEL  5  SIDE
.5

***  PANEL   6  ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  6  DECK
ENTER S TO STOP DATA ENTRY
1
CHOOSE TRANVERS BEAM SIZE FOR PANEL   6
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
 2
 ** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  5  SIDE
0

ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  6  DECK
8

ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  6  DECK
.29

***  PANEL   7  ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  7  SIDE
ENTER S TO STOP DATA ENTRY
1

CHOOSE TRANVERS BEAM SIZE FOR PANEL   7
```

```
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
2
** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  7  SIDE
0

ENTER THE NUMBER OF TRANVERSE OR VERTICAL PLATES IN PANEL  7  SIDE
8

ARE PLATES EVENLY SPACED
 0 = YES   1 = NO
0

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  7  SIDE
.5

***  PANEL   8  ***
ENTER THE NUMBER OF DIFFERENT BEAM SECTIONS IN PANEL  8  SIDE
ENTER S TO STOP DATA ENTRY
2

CHOOSE TRANVERS BEAM SIZE FOR PANEL   8
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
 2
** ENTER THE NUMBER OF LONGITUDINAL BEAMS IN PANEL  8  SIDE
8
```

```
ARE BEAMS EVENLY SPACED
 0 = YES    1 = NO
0

CHOOSE LONGTDL BEAM SIZE FOR PANEL   8
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5X.3
  5   4X3A
  6   12X6T
3

ENTER YOUNGS MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL  8  SIDE
.5

WRITING FILE FRAME.D02

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
```

```
15 = PLOT VAST GEOMETRY FILES
16 = STOP
2
ENTER
FOR SINGLE SECTIONS
0 = TO PLOT SECTION MODEL, OR BEAM NORMALS
    TO CHECK PANEL BEAM GRIDS
    TO APPLY PANEL PRESSURE LOADS
    TO GENERATE A VAST FILE AND BOUNDARY CONDITIONS

FOR ASSEMBLED SECTIONS
1 = APPLY LOADING TO ASSEMBLED SECTION GEOMETRY FILES
2 = APPLY BOUNDARY CONDITIONS TO ASSEMBLED SECTION GEOMETRY FILES
0

ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 30. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
2
READING FILE FRAME.D02
PROCESSING SECTION 2

PLOT SECTION MODEL 2
 0 = YES
 1 = NO
0
```

The newly gridded model is shown in Figure 10.1

```
CHOOSE THE PLANE IN WHICH DECKS ARE TO BE DISPLAYED
1 =  LENGTH OF SHIP ALONG X AXIS
2 =  LENGTH OF SHIP ALONG Z AXIS
2

ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10

0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
```

```
2 = DISPLAY NODES AND NODE NUMBERS
0

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The option list is displayed from which the beam grid check was chosen.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
6

GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  2
0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTLY PLOT PANELS
0
```

The beam grid is shown in Figure 10.2. It can be plotted a panel at a time for inspection for duplicate beams.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
8

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
```

```
      GENERATE LOADS OR BOUNDARY CONDITIONS
  3 = EDIT EXISTING MODEL
  4 = ADD TO EXISTING MODEL
  5 = EXAMINE OR EDIT BEAM DATA FILE
  6 = CREATE NEW MODEL FROM EXISTING PANELS
  7 = MIRROR AN EXISTING SECTION
  8 = PLOT ASSEMBLY OF EXISTING SECTIONS
  9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
 10 = GENERATE A PATRAN MODEL
 11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
 12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
 13 = CREATE REPEATING SECTION GEOMETRY FILES
 14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
 15 = PLOT VAST GEOMETRY FILES
 16 = STOP
 16

FORTRAN STOP
```

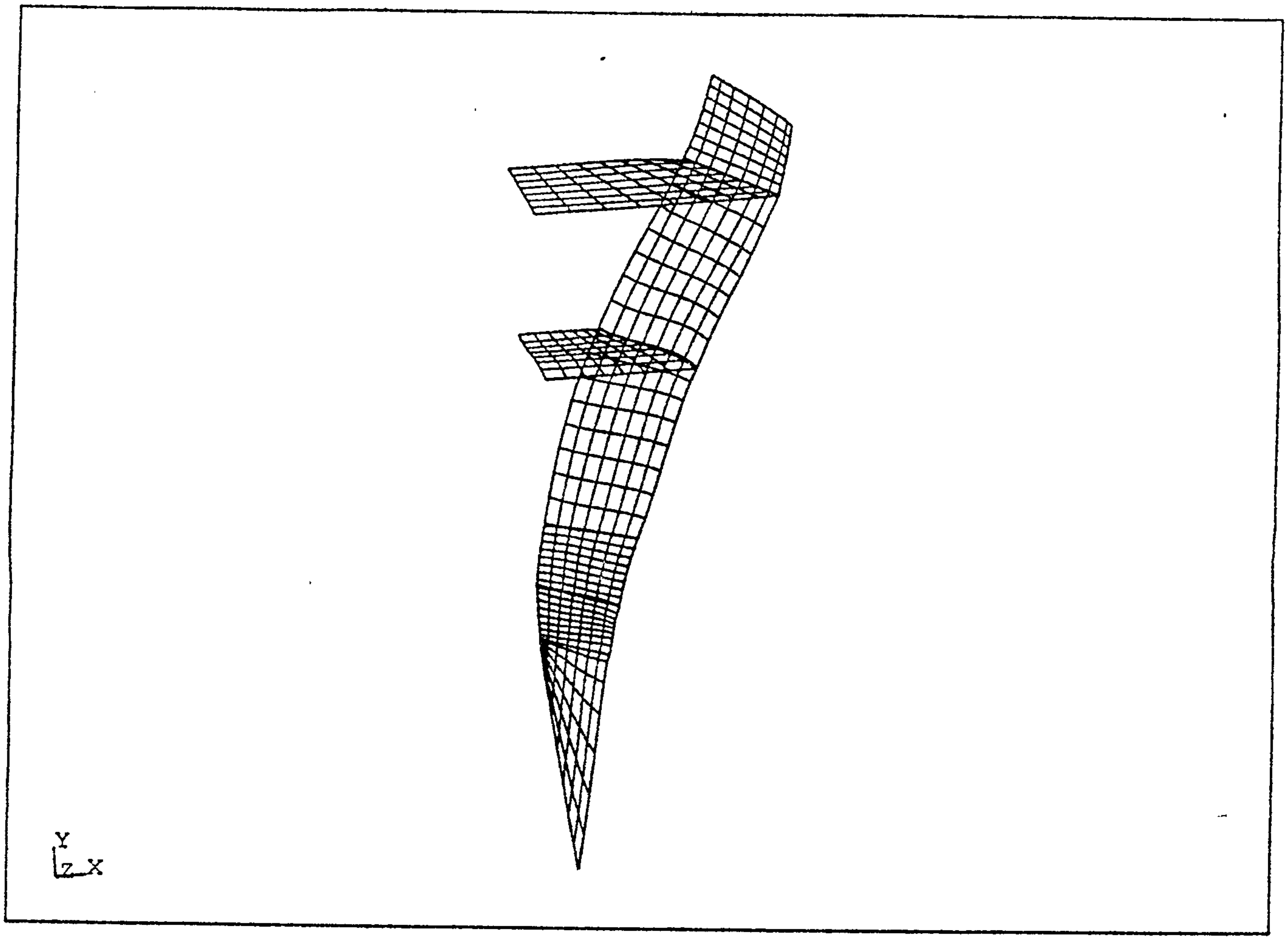


Figure 10.1: New Grid On Original Panels Of Section 2

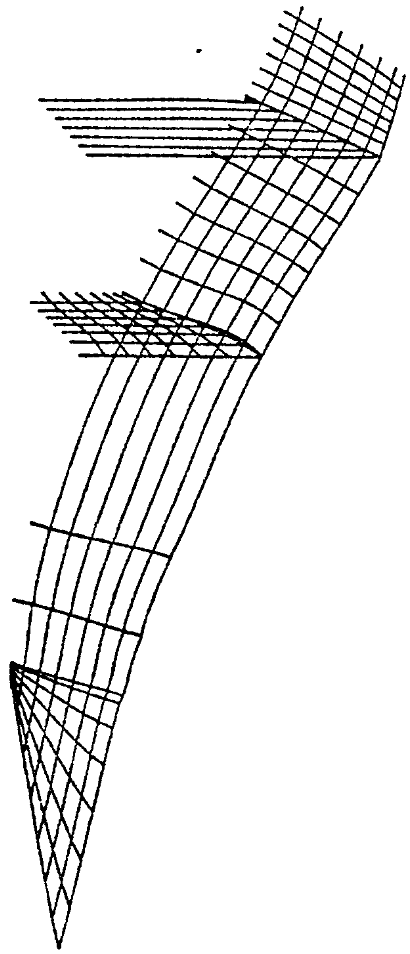


Figure 10.2: New Beam Grid Plotted For Inspection

Chapter 11

Option 7 Mirror An Existing Section

An existing gridded half section model can be mirrored to form a full ship hull crossection. The panels are also mirrored as part of the process which will allow panels to be added to the the full section as well as the half section as shown in Chapter 9. This will allow unsymmetric structure to be modelled. Every panel of a half section also need not be mirrored to further account for unsymmetric portions.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
```

```
7
ENTER THE NUMBER OF THE FIRST AND LAST SECTION TO BE MIRRORED
2 2
```

A range of half sections can be entered for mirror imaging. In this case only section 2 of Chapter 10 has been entered.

```
READING FILE FRAME.D02
MIRROR IMAGING SECTION  2
MIRROR ALL PANELS OF SECTION  2
1 = YES  2 = NO
1
```

At this stage any panels that are not symmetrical about the center line can be left out of the mirroring process.

```
WRITING FILE FRAME.D02
```

The mirror file is created by overwriting the half section file.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
2
```

The full section can now be plotted by using Option 2 of the main menu.

```
ENTER
FOR SINGLE SECTIONS
0 = TO PLOT SECTION MODEL, OR BEAM NORMALS
    TO CHECK PANEL BEAM GRIDS
    TO APPLY PANEL PRESSURE LOADS
    TO GENERATE A VAST FILE AND BOUNDARY CONDITIONS

FOR ASSEMBLED SECTIONS
1 = APPLY LOADING TO ASSEMBLED SECTION GEOMETRY FILES
2 = APPLY BOUNDARY CONDITIONS TO ASSEMBLED SECTION GEOMETRY FILES
0

ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 90. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
2

READING FILE FRAME.D02
PROCESSING SECTION  2

PLOT SECTION MODEL  2
 0 = YES
 1 = NO
0

CHOOSE THE PLANE IN WHICH DECKS ARE TO BE DISPLAYED
1 =  LENGTH OF SHIP ALONG X AXIS
2 =  LENGTH OF SHIP ALONG Z AXIS
2

ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10

0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
```

```
2 = DISPLAY NODES AND NODE NUMBERS
0

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The full section resulting from the mirroring of the half section 2 is shown in Figure 11.1

```
 As a further demonstration section 3 is plotted before mirroring to
show how a longitudinal bulkhead on the centerline can eliminated
from the mirroring process.

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
2

ENTER
FOR SINGLE SECTIONS
0 = TO PLOT SECTION MODEL, OR BEAM NORMALS
    TO CHECK PANEL BEAM GRIDS
    TO APPLY PANEL PRESSURE LOADS
    TO GENERATE A VAST FILE AND BOUNDARY CONDITIONS
```

```
FOR ASSEMBLED SECTIONS
1 = APPLY LOADING TO ASSEMBLED SECTION GEOMETRY FILES
2 = APPLY BOUNDARY CONDITIONS TO ASSEMBLED SECTION GEOMETRY FILES
0

ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 90. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
3
READING FILE FRAME.D03
PROCESSING SECTION  3

PLOT SECTION MODEL  3
 0 = YES
 1 = NO
0
CHOOSE THE PLANE IN WHICH DECKS ARE TO BE DISPLAYED
1 =  LENGTH OF SHIP ALONG X AXIS
2 =  LENGTH OF SHIP ALONG Z AXIS
2
ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10
0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
0
0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

A plot of the unmirrored half section is shown in Figure 11.2. The longitudinal bulkhead attached to the deck is panel 11.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
```

```
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
8

 Return to the main menu for mirroring.

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
7

ENTER THE NUMBER OF THE FIRST AND LAST SECTION TO BE MIRRORED
3 3

READING FILE FRAME.D03
MIRROR IMAGING SECTION  3
MIRROR ALL PANELS OF SECTION  3
1 = YES  2 = NO
2
MIRROR PANEL 11
1 = YES
2 = NO
3 = STOP
```

```
2

 Panel 11 is the bulkhead on the centerline which must not be duplicated
by the mirroring process.

MIRROR PANEL 10
1 = YES
2 = NO
3 = STOP
1
MIRROR PANEL  9
1 = YES
2 = NO
3 = STOP
1
MIRROR PANEL  8
1 = YES
2 = NO
3 = STOP
1
MIRROR PANEL  7
1 = YES
2 = NO
3 = STOP
1
MIRROR PANEL  6
1 = YES
2 = NO
3 = STOP
1
MIRROR PANEL  5
1 = YES
2 = NO
3 = STOP
1
MIRROR PANEL  4
1 = YES
2 = NO
3 = STOP
```

```
1
MIRROR PANEL  3
1 = YES
2 = NO
3 = STOP
1
MIRROR PANEL  2
1 = YES
2 = NO
3 = STOP
1
MIRROR PANEL  1
1 = YES
2 = NO
3 = STOP
1

WRITING FILE FRAME.D03

 The mirroring is completed by overwriting FRAME.D03.

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
```

```
2

 Plot the model for inspection.

ENTER
FOR SINGLE SECTIONS
0 = TO PLOT SECTION MODEL, OR BEAM NORMALS
    TO CHECK PANEL BEAM GRIDS
    TO APPLY PANEL PRESSURE LOADS
    TO GENERATE A VAST FILE AND BOUNDARY CONDITIONS

FOR ASSEMBLED SECTIONS
1 = APPLY LOADING TO ASSEMBLED SECTION GEOMETRY FILES
2 = APPLY BOUNDARY CONDITIONS TO ASSEMBLED SECTION GEOMETRY FILES
0

ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 90. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
3

READING FILE FRAME.D03
PROCESSING SECTION  3

PLOT SECTION MODEL  3
 0 = YES
 1 = NO

0
CHOOSE THE PLANE IN WHICH DECKS ARE TO BE DISPLAYED
1 =  LENGTH OF SHIP ALONG X AXIS
2 =  LENGTH OF SHIP ALONG Z AXIS
2

ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10

0 = NO NODES AND NODE NUMBERS
```

```
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
0

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The full crossection is shown in Figure 11.3

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16

FORTRAN STOP
```

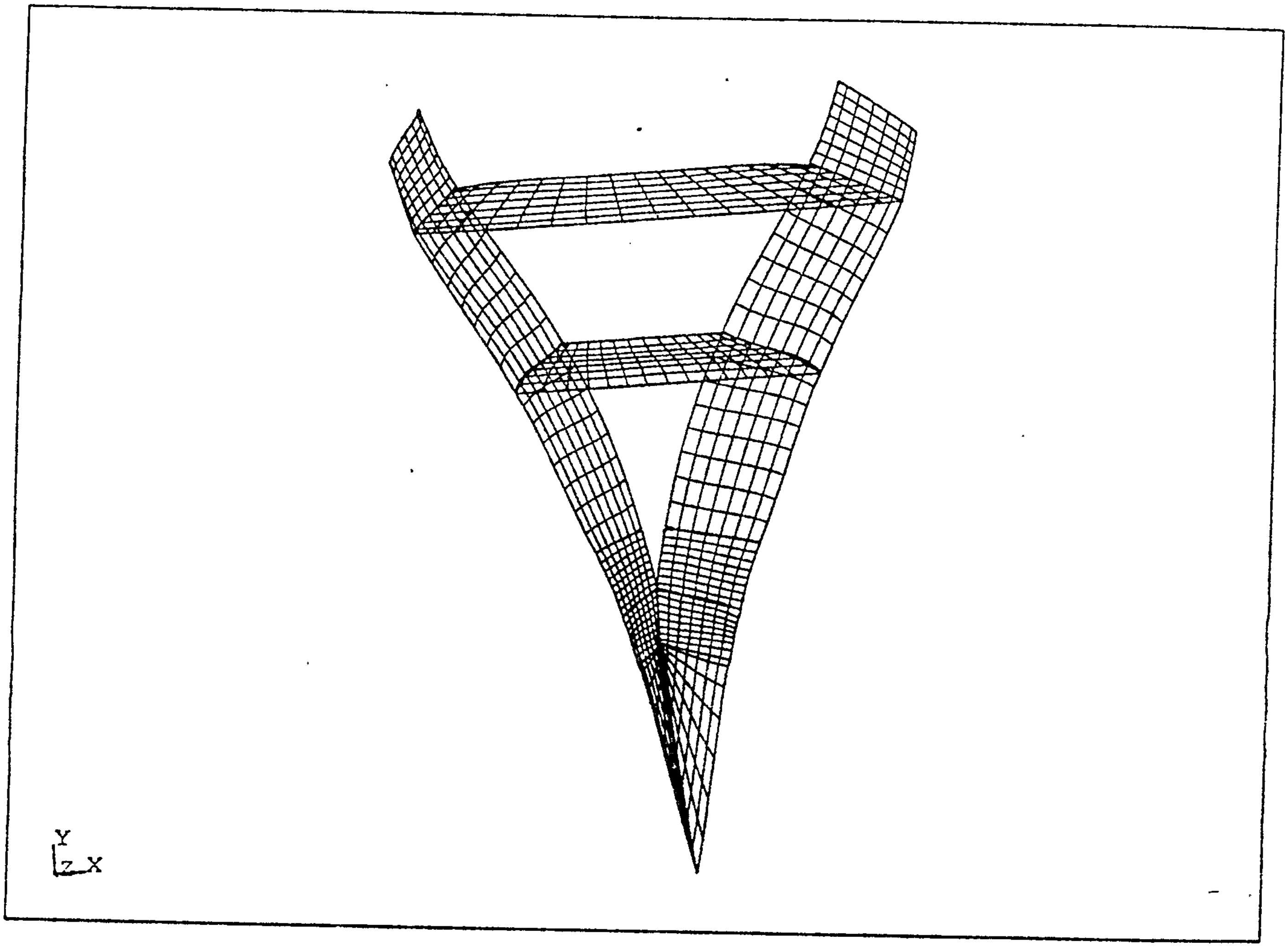


Figure 11.1: Half Section Mirrored To A Full Section

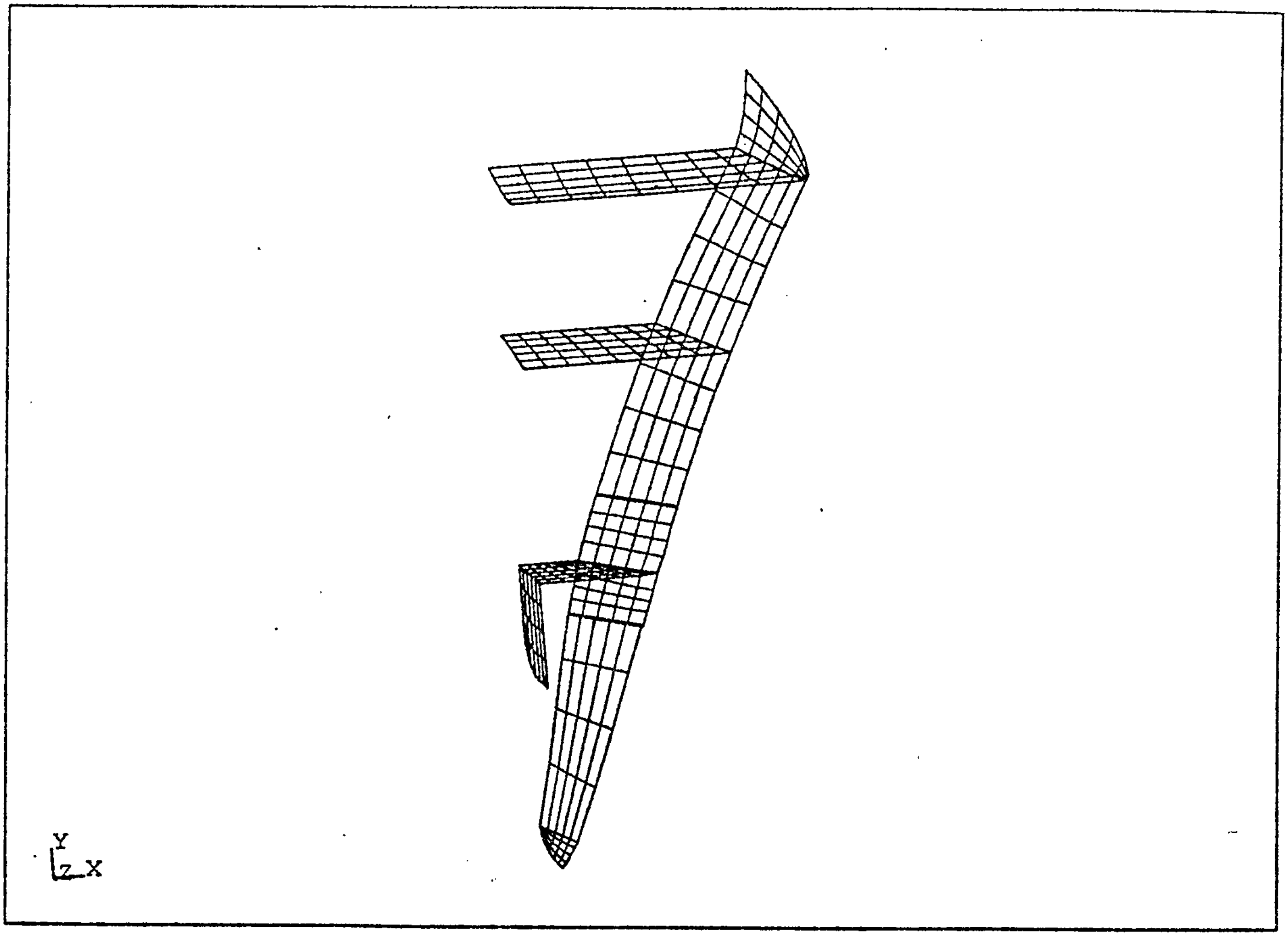


Figure 11.2: Half Section 3 Prior To Mirroring

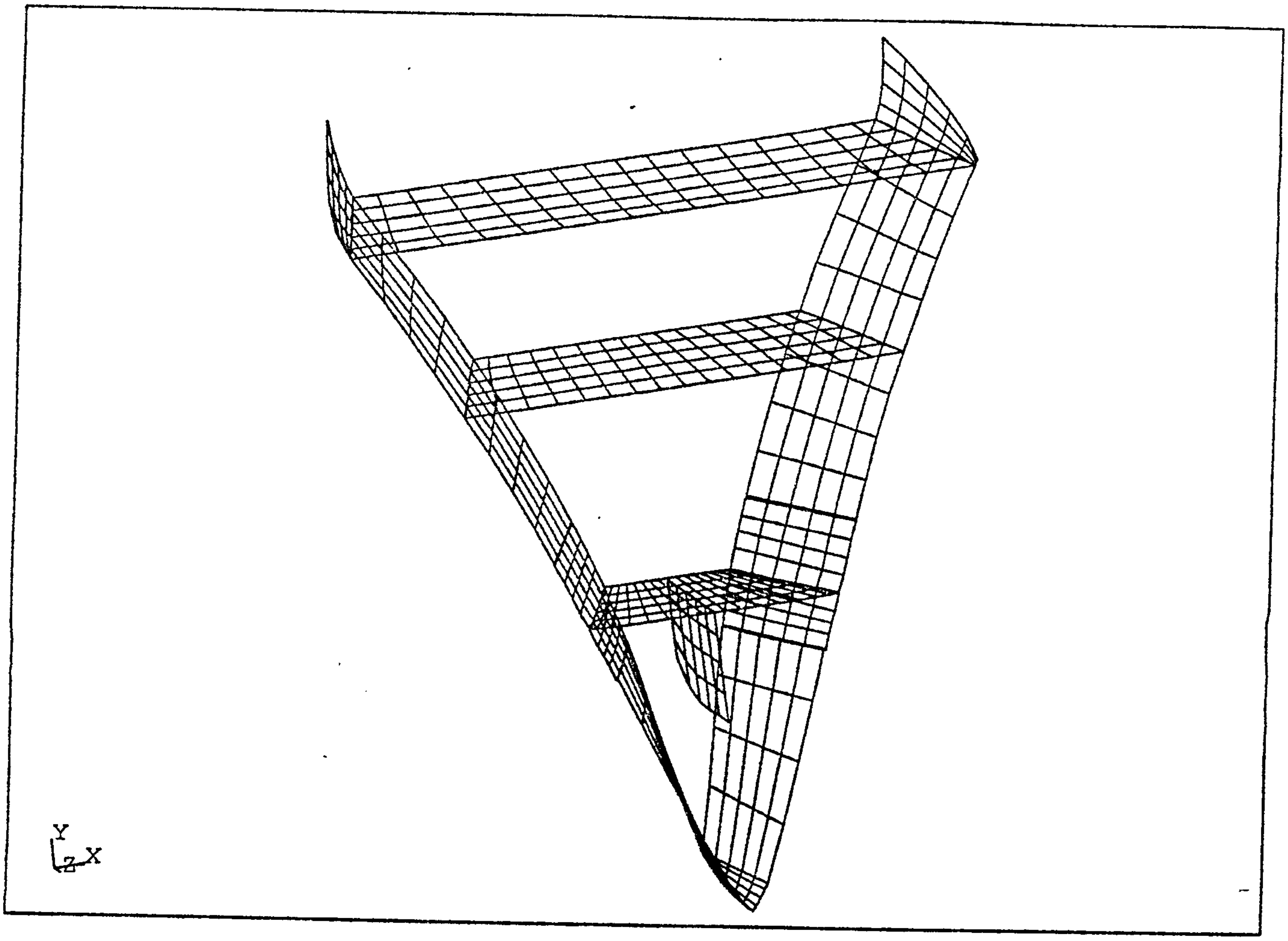


Figure 11.3: Half Section 3 Mirrored To A Full Section

Chapter 12

Option 8 Plot Assembly Of Existing Sections

An assembly of all or a portion of the sections can be displayed for inspection. The display can be rotated about X Y and Z for viewing at any combination of angles.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
8
ENTER
1 = PLOT  RANGE OF SECTIONS
```

```
2 = PLOT SPECIFIC SECTIONS
1
ENTER THE NUMBER OF THE FIRST AND LAST SECTION TO BE PLOTTED
1 5
READING FILE FRAME.D01

PROCESSING SECTION  1
READING FILE FRAME.D02
PROCESSING SECTION  2
READING FILE FRAME.D03
PROCESSING SECTION  3
READING FILE FRAME.D04
PROCESSING SECTION  4
READING FILE FRAME.D05
PROCESSING SECTION  5
ENTER ANGLES OF ROTATION ABOUT XYZ AXES
20 20 20
0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
0
0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

Sections 1 to 5 are shown plotted in Figure 12.1

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
```

```
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
8

ENTER
1 = PLOT  RANGE OF SECTIONS
2 = PLOT SPECIFIC SECTIONS
2

ENTER THE NUMBER OF THE SECTION TO BE PLOTTED OR AN S TO STOP
1

READING FILE FRAME.D01
PROCESSING SECTION  1
ENTER THE NUMBER OF THE SECTION TO BE PLOTTED OR AN S TO STOP
2
READING FILE FRAME.D02
PROCESSING SECTION  2
ENTER THE NUMBER OF THE SECTION TO BE PLOTTED OR AN S TO STOP
20

READING FILE FRAME.D20
PROCESSING SECTION 20
ENTER THE NUMBER OF THE SECTION TO BE PLOTTED OR AN S TO STOP
S

ENTER ANGLES OF ROTATION ABOUT XYZ AXES
20 20 20

0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
0

0 = CONTINUOUSLY PLOT PANELS
```

```
1 = INCREMENTAL PLOTTING OF PANELS
0
```

Sections 1 2 and 20 are shown plotted in Figure 12.2. Section in this case is a tranverse bulkhead.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
8

ENTER
1 = PLOT  RANGE OF SECTIONS
2 = PLOT SPECIFIC SECTIONS
1

ENTER THE NUMBER OF THE FIRST AND LAST SECTION TO BE PLOTTED
1 28

READING FILE FRAME.D01
PROCESSING SECTION  1
READING FILE FRAME.D02
```

```
PROCESSING SECTION  2
READING FILE FRAME.D03
PROCESSING SECTION  3
READING FILE FRAME.D04
PROCESSING SECTION  4
READING FILE FRAME.D05
PROCESSING SECTION  5
READING FILE FRAME.D06
PROCESSING SECTION  6
READING FILE FRAME.D07
PROCESSING SECTION  7
READING FILE FRAME.D08
PROCESSING SECTION  8
READING FILE FRAME.D09
PROCESSING SECTION  9
READING FILE FRAME.D10
PROCESSING SECTION 10
READING FILE FRAME.D11
PROCESSING SECTION 11
READING FILE FRAME.D12
PROCESSING SECTION 12
READING FILE FRAME.D13
PROCESSING SECTION 13
READING FILE FRAME.D14
PROCESSING SECTION 14
READING FILE FRAME.D15
PROCESSING SECTION 15
READING FILE FRAME.D16
PROCESSING SECTION 16
READING FILE FRAME.D17
PROCESSING SECTION 17
READING FILE FRAME.D18
PROCESSING SECTION 18
READING FILE FRAME.D19
PROCESSING SECTION 19
READING FILE FRAME.D20
PROCESSING SECTION 20
READING FILE FRAME.D21
PROCESSING SECTION 21
```

```
READING FILE FRAME.D22
PROCESSING SECTION 22
READING FILE FRAME.D23
PROCESSING SECTION 23
READING FILE FRAME.D24
PROCESSING SECTION 24
READING FILE FRAME.D25
PROCESSING SECTION 25
READING FILE FRAME.D26
PROCESSING SECTION 26
READING FILE FRAME.D27
PROCESSING SECTION 27
READING FILE FRAME.D28
PROCESSING SECTION 28

ENTER ANGLES OF ROTATION ABOUT XYZ AXES
10 10 10

0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
0

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The sections from 1 to 28 are shown in Figure 12.3.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
```

```
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
8

ENTER
1 = PLOT  RANGE OF SECTIONS
2 = PLOT SPECIFIC SECTIONS
1

ENTER THE NUMBER OF THE FIRST AND LAST SECTION TO BE PLOTTED
1 28

READING FILE FRAME.D01
PROCESSING SECTION  1
READING FILE FRAME.D02
PROCESSING SECTION  2
READING FILE FRAME.D03
PROCESSING SECTION  3
READING FILE FRAME.D04
PROCESSING SECTION  4
READING FILE FRAME.D05
PROCESSING SECTION  5
READING FILE FRAME.D06
PROCESSING SECTION  6
READING FILE FRAME.D07
PROCESSING SECTION  7
READING FILE FRAME.D08
PROCESSING SECTION  8
READING FILE FRAME.D09
PROCESSING SECTION  9
READING FILE FRAME.D10
PROCESSING SECTION 10
```

```
READING FILE FRAME.D11
PROCESSING SECTION 11
READING FILE FRAME.D12
PROCESSING SECTION 12
READING FILE FRAME.D13
PROCESSING SECTION 13
READING FILE FRAME.D14
PROCESSING SECTION 14
READING FILE FRAME.D15
PROCESSING SECTION 15
READING FILE FRAME.D16
PROCESSING SECTION 16
READING FILE FRAME.D17
PROCESSING SECTION 17
READING FILE FRAME.D18
PROCESSING SECTION 18
READING FILE FRAME.D19
PROCESSING SECTION 19
READING FILE FRAME.D20
PROCESSING SECTION 20
READING FILE FRAME.D21
PROCESSING SECTION 21
READING FILE FRAME.D22
PROCESSING SECTION 22
READING FILE FRAME.D23
PROCESSING SECTION 23
READING FILE FRAME.D24
PROCESSING SECTION 24
READING FILE FRAME.D25
PROCESSING SECTION 25
READING FILE FRAME.D26
PROCESSING SECTION 26
READING FILE FRAME.D27
PROCESSING SECTION 27
READING FILE FRAME.D28
PROCESSING SECTION 28

ENTER ANGLES OF ROTATION ABOUT XYZ AXES
0 90 0
```

```
0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
0

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

Sections 1 to 28 rotated 90 degrees to produce a side view of the model are shown in Figure 12.4

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
8

ENTER
1 = PLOT  RANGE OF SECTIONS
2 = PLOT SPECIFIC SECTIONS
1
```

```
ENTER THE NUMBER OF THE FIRST AND LAST SECTION TO BE PLOTTED
1 28

READING FILE FRAME.D01
PROCESSING SECTION  1
READING FILE FRAME.D02
PROCESSING SECTION  2
READING FILE FRAME.D03
PROCESSING SECTION  3
READING FILE FRAME.D04
PROCESSING SECTION  4
READING FILE FRAME.D05
PROCESSING SECTION  5
READING FILE FRAME.D06
PROCESSING SECTION  6
READING FILE FRAME.D07
PROCESSING SECTION  7
READING FILE FRAME.D08
PROCESSING SECTION  8
READING FILE FRAME.D09
PROCESSING SECTION  9
READING FILE FRAME.D10
PROCESSING SECTION 10
READING FILE FRAME.D11
PROCESSING SECTION 11
READING FILE FRAME.D12
PROCESSING SECTION 12
READING FILE FRAME.D13
PROCESSING SECTION 13
READING FILE FRAME.D14
PROCESSING SECTION 14
READING FILE FRAME.D15
PROCESSING SECTION 15
READING FILE FRAME.D16
PROCESSING SECTION 16
READING FILE FRAME.D17
PROCESSING SECTION 17
READING FILE FRAME.D18
PROCESSING SECTION 18
```

```
READING FILE FRAME.D19
PROCESSING SECTION 19
READING FILE FRAME.D20
PROCESSING SECTION 20
READING FILE FRAME.D21
PROCESSING SECTION 21
READING FILE FRAME.D22
PROCESSING SECTION 22
READING FILE FRAME.D23
PROCESSING SECTION 23
READING FILE FRAME.D24
PROCESSING SECTION 24
READING FILE FRAME.D25
PROCESSING SECTION 25
READING FILE FRAME.D26
PROCESSING SECTION 26
READING FILE FRAME.D27
PROCESSING SECTION 27
READING FILE FRAME.D28
PROCESSING SECTION 28

ENTER ANGLES OF ROTATION ABOUT XYZ AXES
0 -80 0

0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
0

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

Sections 1 to 25 rotated -80 degrees are shown in Figure 12.5.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
```

```
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
FORTRAN STOP
```

Additional graphics of the model in the form of hard copies of displays generated on a Silicon Graphics Personal Iris work station are shown in Appendix I.

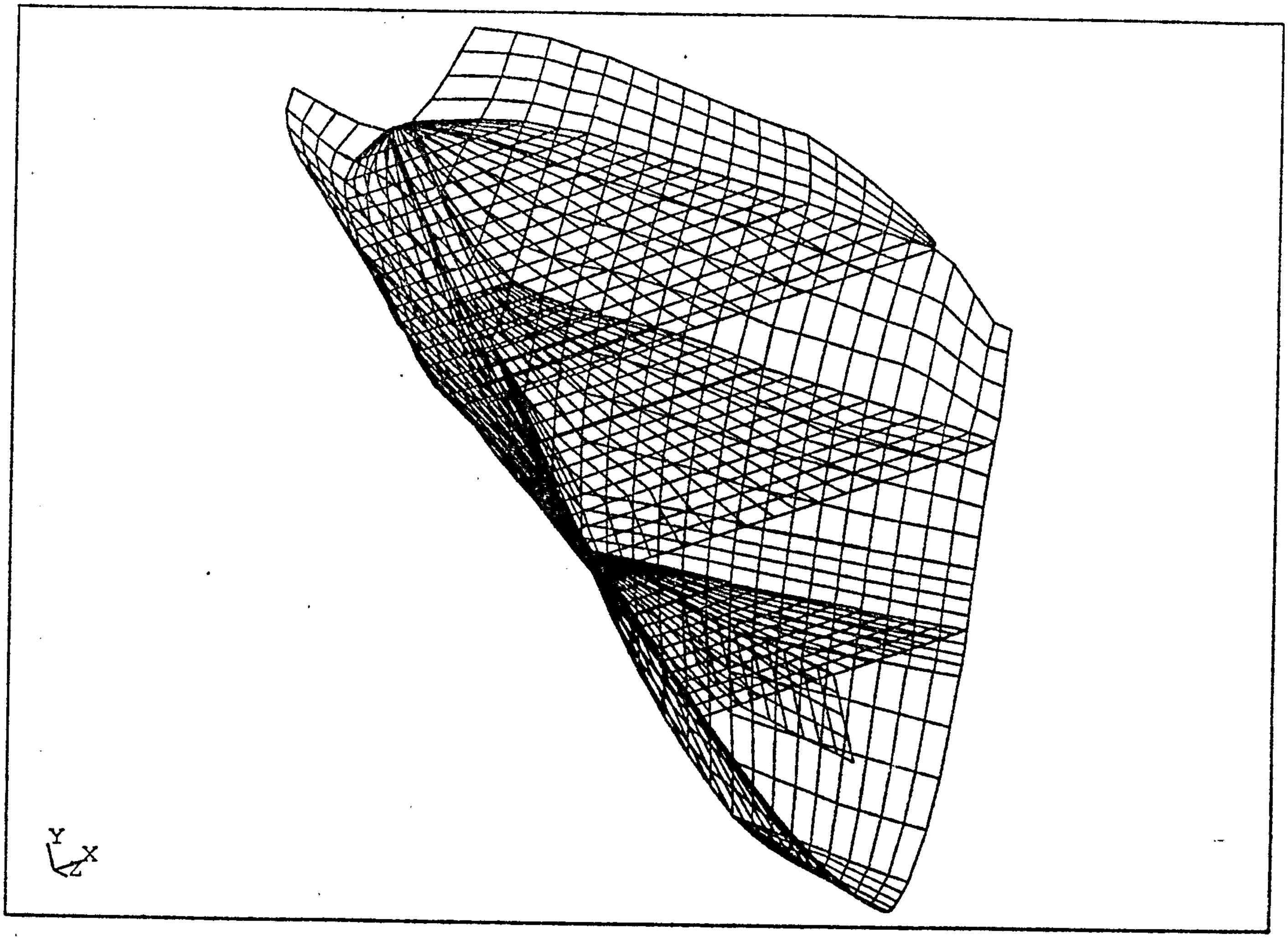


Figure 12.1: A Plot Of Sections 1 To 5

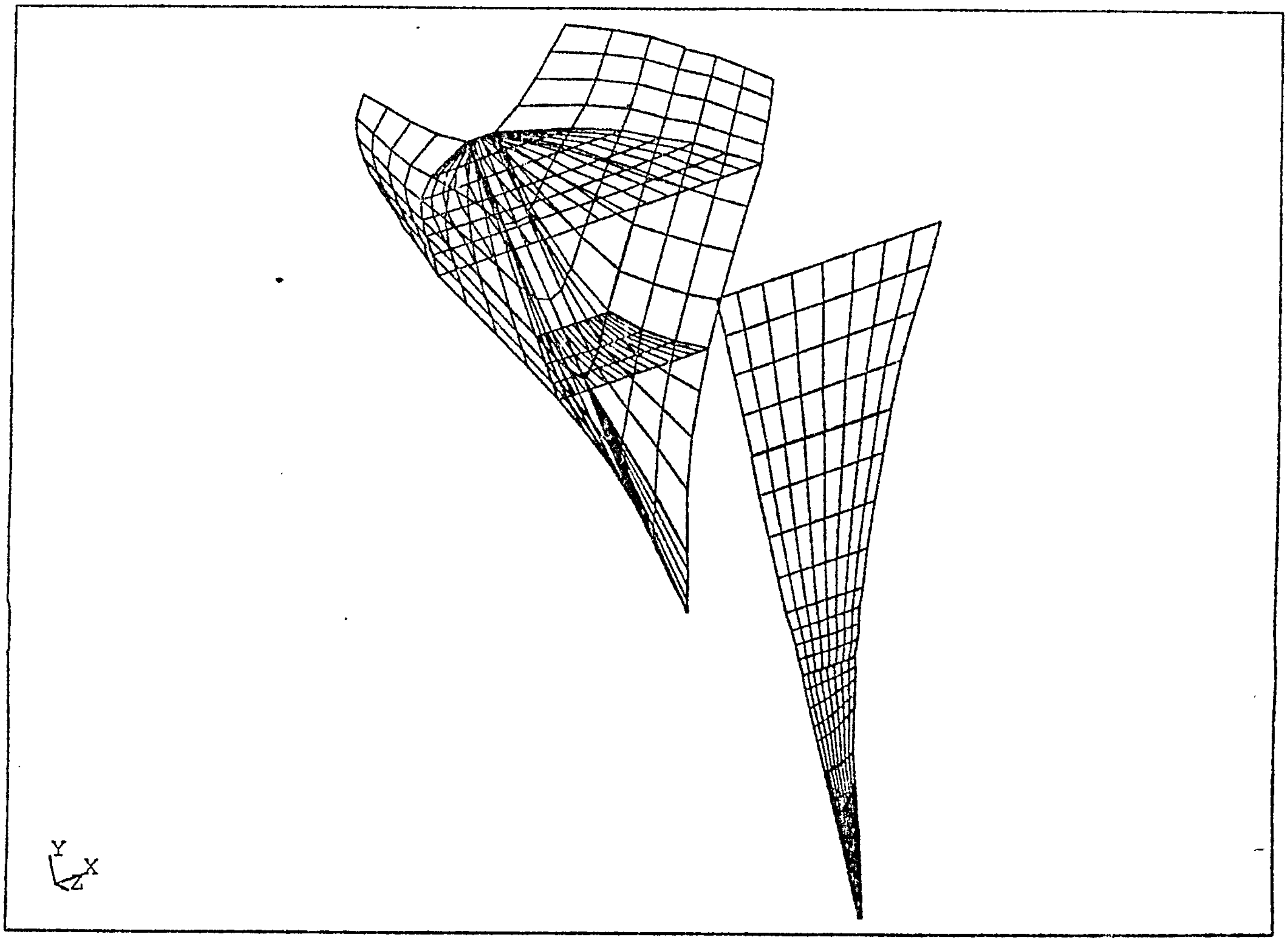


Figure 12.2: A Plot Of Sections 1, 2 And 20

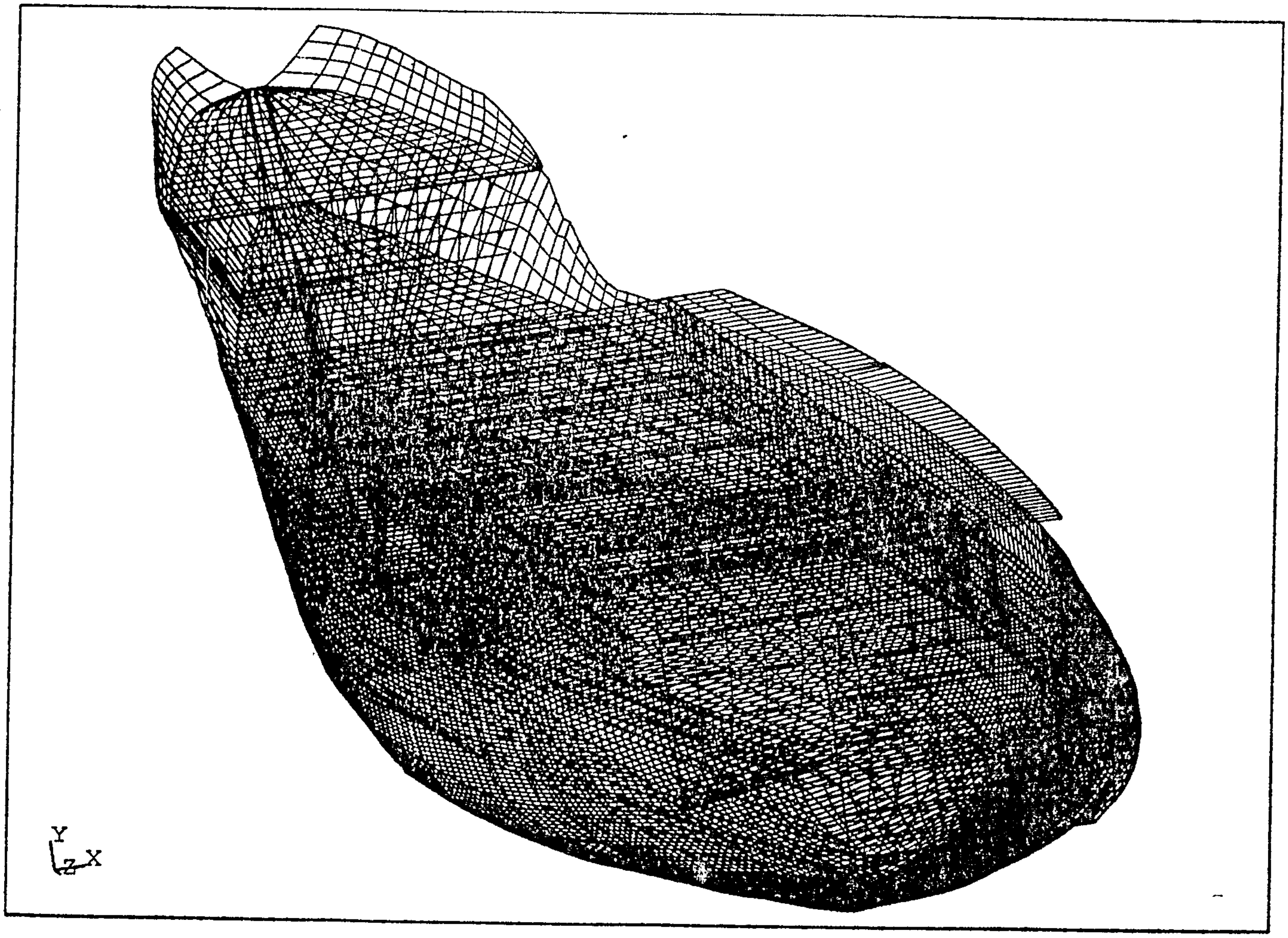


Figure 12.3: A Plot Of All The Sections Forming The Model Rotated 20 Degrees About X Y And Z

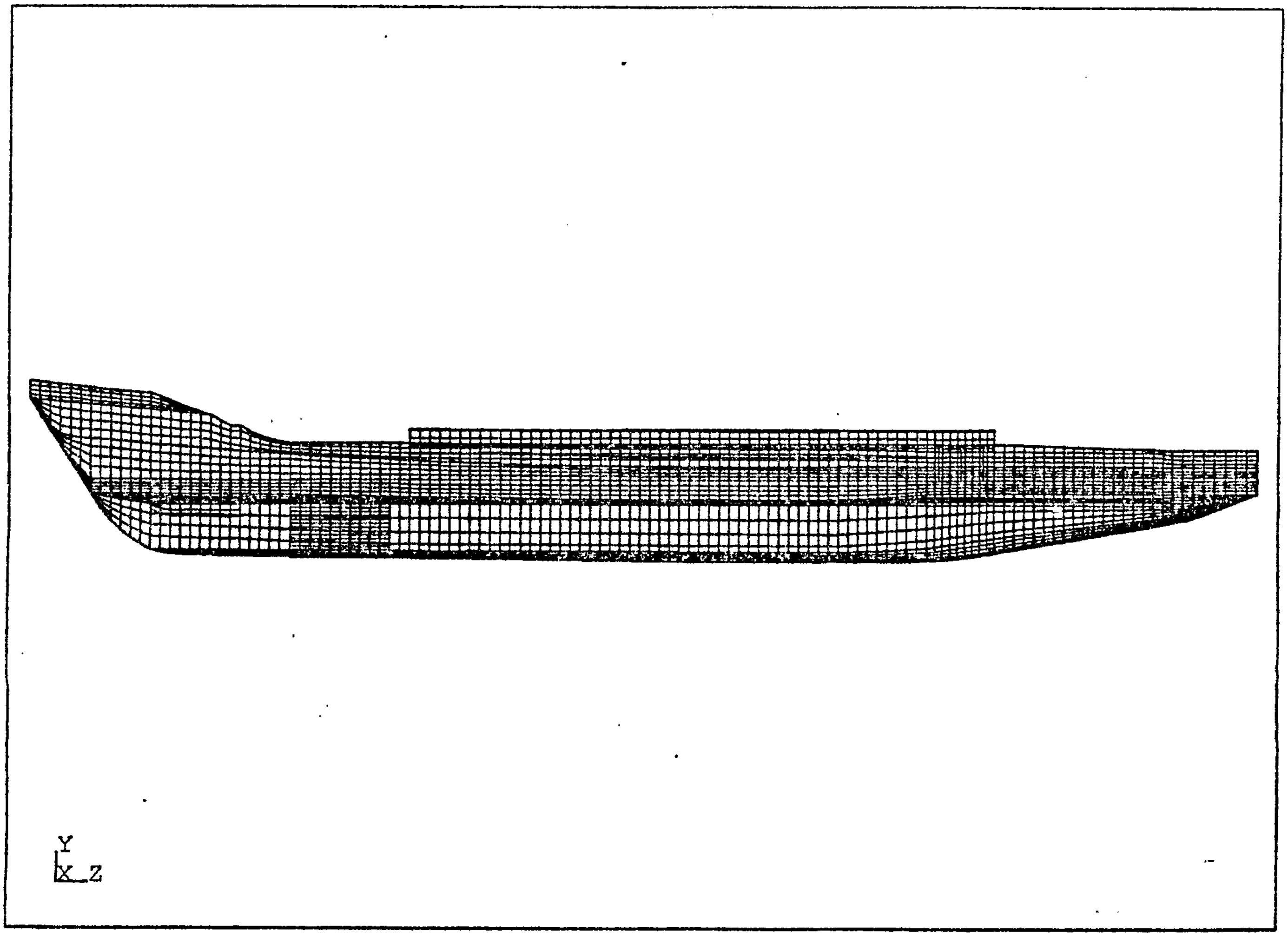


Figure 12.4: A Plot Of All Sections Of The Model Rotated 90 Degrees About Y

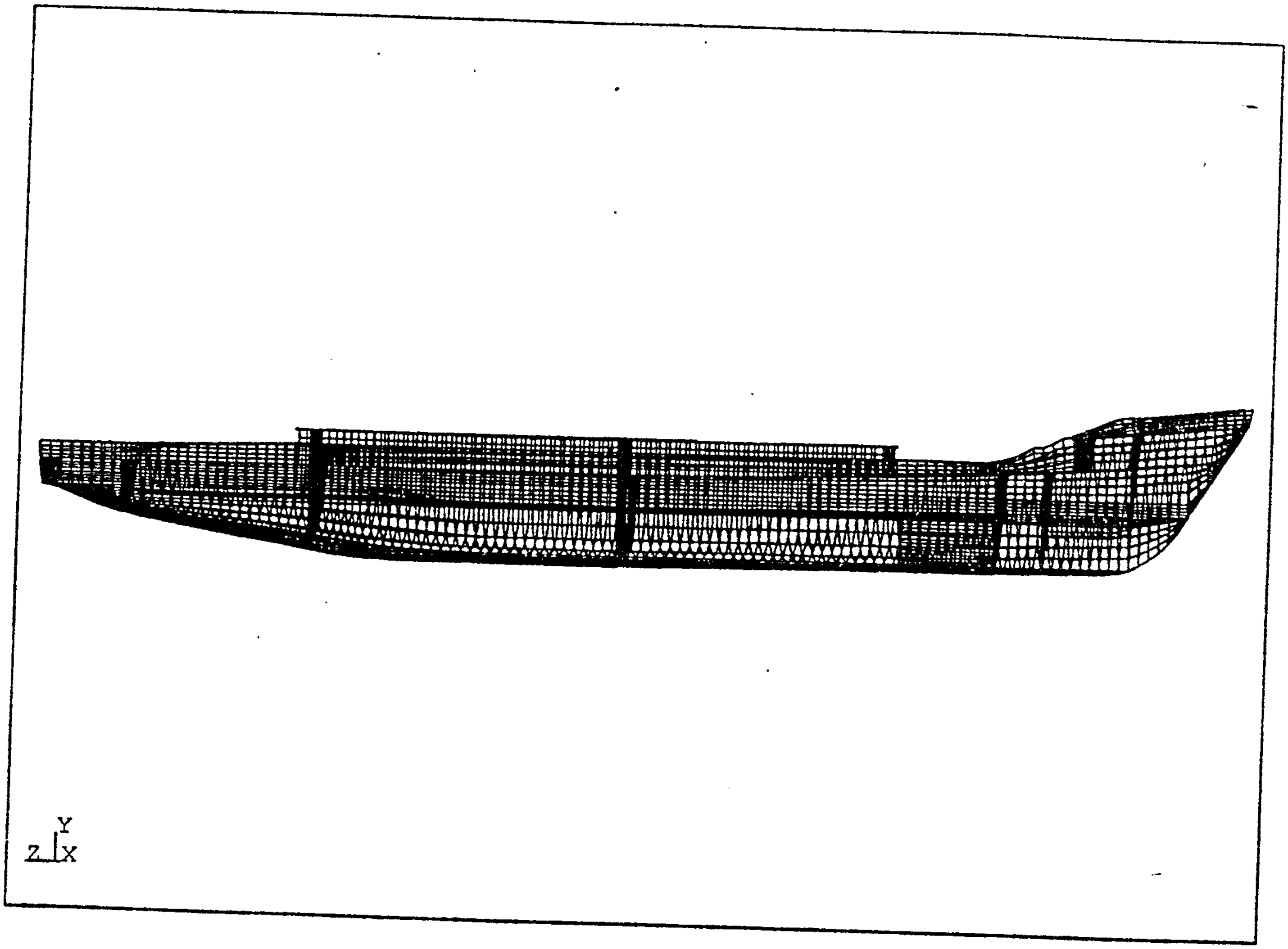


Figure 12.5: A Plot Of All Sections Of The Model Rotated -80 Degrees About Y

Chapter 13

Option 9 Model Bulkhead At Generated Frame Location

Tranverse bulkheads are modelled with this option. The modelling is not limited with respect to the number of panels used. The location of the bulkhead must coincide with a frame position. The reference data on the crossection displayed for bulkhead generation includes the node locations of the gridded side and deck panels at the chosen frame location.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
9
```

```
SHIP NAME FOR BEAM DATA
CNAV QUEST
0 = CONTINUE
1 = CHANGE NAME
0

ENTER BULKHD MODEL SECTION NUMBER
THE NUMBER SHOULD FOLLOW ON FROM THE LAST
SECTION NUMBER DEFINING THE HULL
33

SECTION 33 MODEL EXISTS
0 = OVERWRITE
1 = CHANGE SECTION NUMBER
1

ENTER BULKHD MODEL SECTION NUMBER
THE NUMBER SHOULD FOLLOW ON FROM THE LAST
SECTION NUMBER DEFINING THE HULL
34

ENTER THE NUMBER OF THE SECTION WHERE THE BULKHEAD IS
TO BE LOCATED
12

READING FILE FRAME.D12
PROCESSING SECTION 34

FRAME LOCATIONS IN SECTION 12
    1271.96
    1296.04
    1320.04
    1344.01
    1367.98
    1391.99
    1416.06
ENTER BULKHD LOCATION FROM FRAME LOCATION LIST
1271.96
```

```
1 = HULL SECTION IS HALF FRAME
2 = HULL SECTION HAS BEEN MIRRORED TO FULL FRAME
E AFTER DEFINITION ENDS PANEL DEFINITION
2

LOCATE PANELS WITH CURSOR
ENTER E TO END INPUT
```

The outline of the hull half section is displayed as shown in Figure 13.1. The nodes of the attached gridded panel are marked with circles, for reference in modelling the panels, and the panel coordinates of the attached panel are marked with X's. Figure 13.2 shows the nodes that have been chosen to define the panels and Figure 13.3 shows the numbered panels. Numbering the panels clockwise puts the beams on the nearest side. ** At this stage it is important to note that the number of transverse beams is the same for each panel in this version of SHPHUL. If the numbers must vary for each panel then each panel must be made a separate section.** The other option is to use more panels in defining the height of the bulkhead.

```
A BEAM DATA FILE EXISTS CHOOSE FROM FOLLOWING
1 = USE EXISTING BEAM DATA
2 = CREATE A NEW BEAM DATA FILE
3 = EXAMINE OR EDIT EXISTING FILE
1

ENTER THE AXIS ALONG WHICH THE LENGTH OF THE HULL
IS MEASURED
Z

CHOOSE FROM MODELLING OPTIONS
1 = STRAIGHT SIDED PANELS BETWEEN END FRAMES
2 = CURVILINEAR PANELS BETWEEN END FRAMES
2

2 PANELS IN SECTION 34

 PANEL GRIDDING
1 = DECKS AND HULL SHELL
2 = LONGITUDINAL BULKHEADS
3 = TRANVERSE BULKHEADS
```

```
4 = STERN OR BOW BULKHEAD
5 = STOP

ENTER TITLE OF SECTION MODELLED (MAX 50 CHAR)
TEST

ENTER THE NUMBER OF TRANSVERSE BEAMS ON
BULKHD PANEL 1
5

ENTER THE NUMBER OF ELEMENTS BETWEEN BEAMS
1

ARE THE BEAMS EVENLY SPACED
0 = YES   1 = NO

*** PANEL    1 ***
ENTER THE NUMBER OF DIFFERENT BEAM SIZES IN PANEL 1 TBULK
ENTER S TO STOP DATA ENTRY
2

CHOOSE TRANVERS. BEAM SIZE FOR PANEL

  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5A
  5   4X3A
  6   12X6T
1

** ENTER THE NUMBER OF VERTICAL BEAMS IN PANEL 1 TBULK
5

ARE BEAMS EVENLY SPACED
0 = YES   1 = NO
0

CHOOSE VERTICAL BEAM SIZE FOR PANEL 1
```

```
  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5A
  5   4X3A
  6   12X6T
2

ENTER YOUNG'S MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
30000000

ENTER POISSON'S RATIO
.3

ENTER DENSITY
.000734

ENTER THE PLATE THICKNESS FOR PANEL 1 TBULK
.250

*** PANEL   2 ***
ENTER THE NUMBER OF DIFFERENT BEAM SIZES IN PANEL 2 TBULK
ENTER S TO STOP DATA ENTRY
1

CHOOSE TRANVERS. BEAM SIZE FOR PANEL

  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5A
  5   4X3A
  6   12X6T
1

** ENTER THE NUMBER OF VERTICAL BEAMS IN PANEL 2 TBULK
5
```

```
ARE BEAMS EVENLY SPACED
0 = YES   1 = NO
0

ENTER YOUNG'S MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL 2  TBULK
.250

*** PANEL   3 ***
ENTER THE NUMBER OF DIFFERENT BEAM SIZES IN PANEL 3 TBULK
ENTER S TO STOP DATA ENTRY
1

CHOOSE TRANVERS. BEAM SIZE FOR PANEL

  1   6X1PL
  2   6X3.5A
  3   4X.5PL
  4   6X3.5A
  5   4X3A
  6   12X6T
1

** ENTER THE NUMBER OF VERTICAL BEAMS IN PANEL  3 TBULK
4

ARE BEAMS EVENLY SPACED
0 = YES   1 = NO
0

ENTER YOUNG'S MODULUS FOR THE PANEL
IF MATERIAL IS THE SAME AS PREVIOUS PANEL ENTER S
S

ENTER THE PLATE THICKNESS FOR PANEL 3  TBULK
```

```
.250

WRITING FILE FRAME.D34

PROCESSING SECTION 34

PLOT SECTION MODEL 34
 0 = YES
 1 =  NO
0

CHOOSE THE PLANE IN WHICH DECKS ARE DISPLAYED
1 = LENGTH OF SHIP ALONG X AXIS
2 = LENGTH OF SHIP ALONG Z AXIS
2
3
ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10

0 = NO NODES AND NODE NUMBERS
1 = DISPLAY NODES
2 = DISPLAY NODES AND NODE NUMBERS
0

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

The gridded bulkhead is shown in Figure 13.4

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
4
```

```
ENTER SCREEN DISPLAY REDUCTION AS % OF FULL SCREEN
10

0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTAL PLOTTING OF PANELS
0
```

A plot of the normals to the bulkhead identifing the side on which the beams are attached is shown in Figure 13.5.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
6

GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION 35
0 = CONTINUOUSLY PLOT PANELS
1 = INCREMENTLY PLOT PANELS
0
```

The beams attached to the panel are shown in Figure 13.6. In this case tranverse as well as vertical beams were installed.

```
2 = EDIT MODEL
3 = CHOOSE ANOTHER VIEW
4 = DISPLAY HULL PANEL NORMALS
5 = GENERATE VAST FILE FOR MODEL
6 = CHECK PANEL BEAM GRID
7 = APPLY PRESSURE LOADS TO HULL PANELS
8 = RETURN TO MAIN MENU
8

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
```

```
    GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16

FORTRAN STOP
```

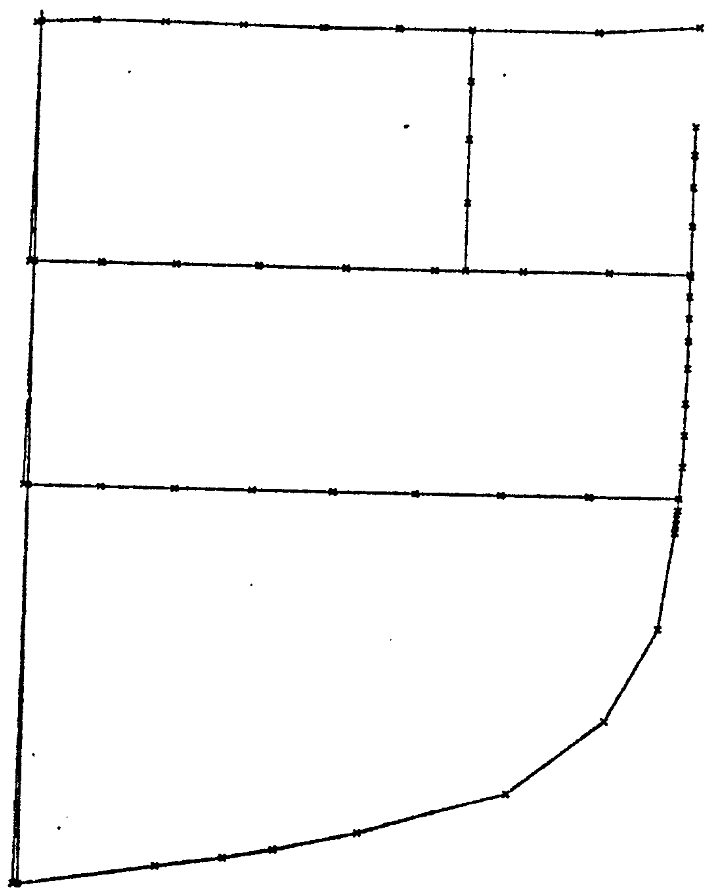


Figure 13.1: The Crossection At Which The Bulkhead Is To Be Installed

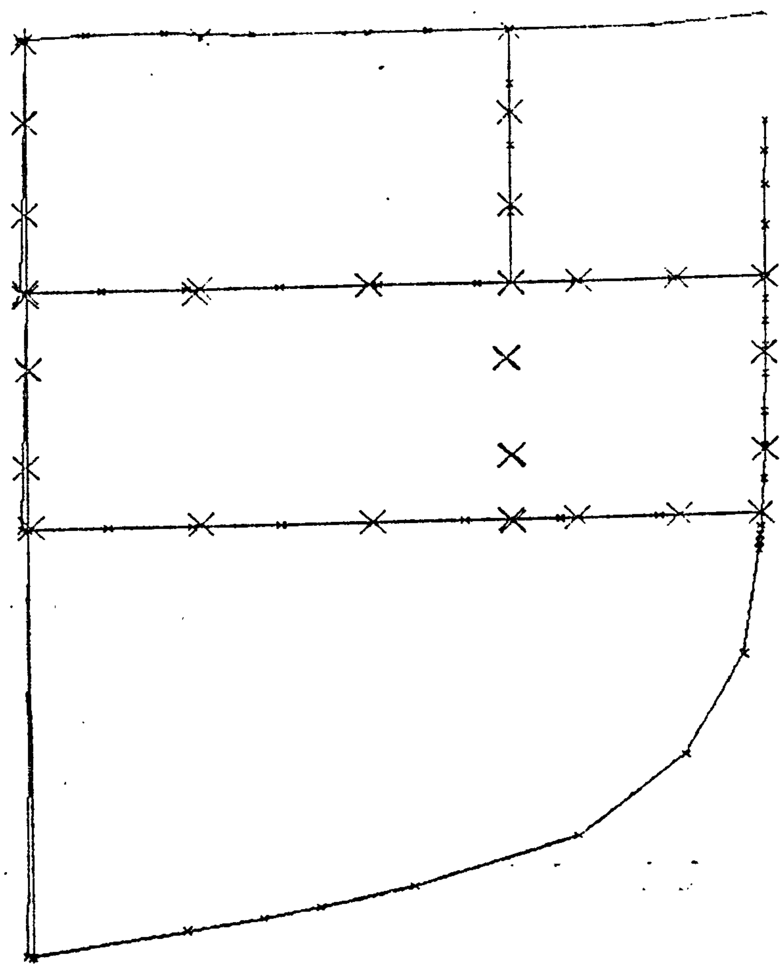


Figure 13.2: The Points On The Crossection Located By The Screen Curser To Define The Panels

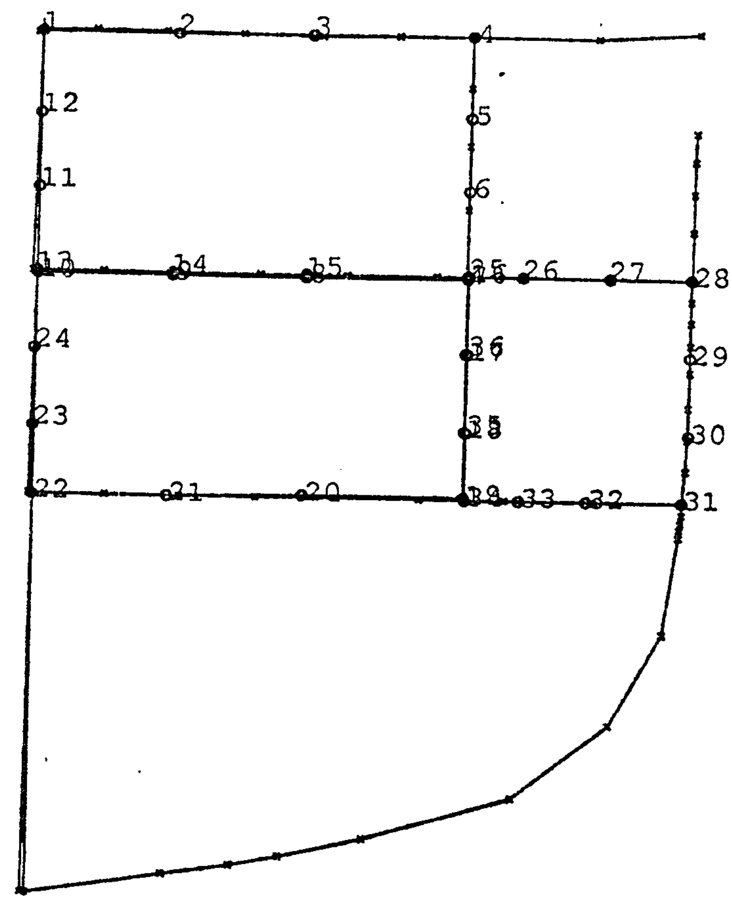


Figure 13.3: The Numbered Panels Superimposed On The Hull Crossection

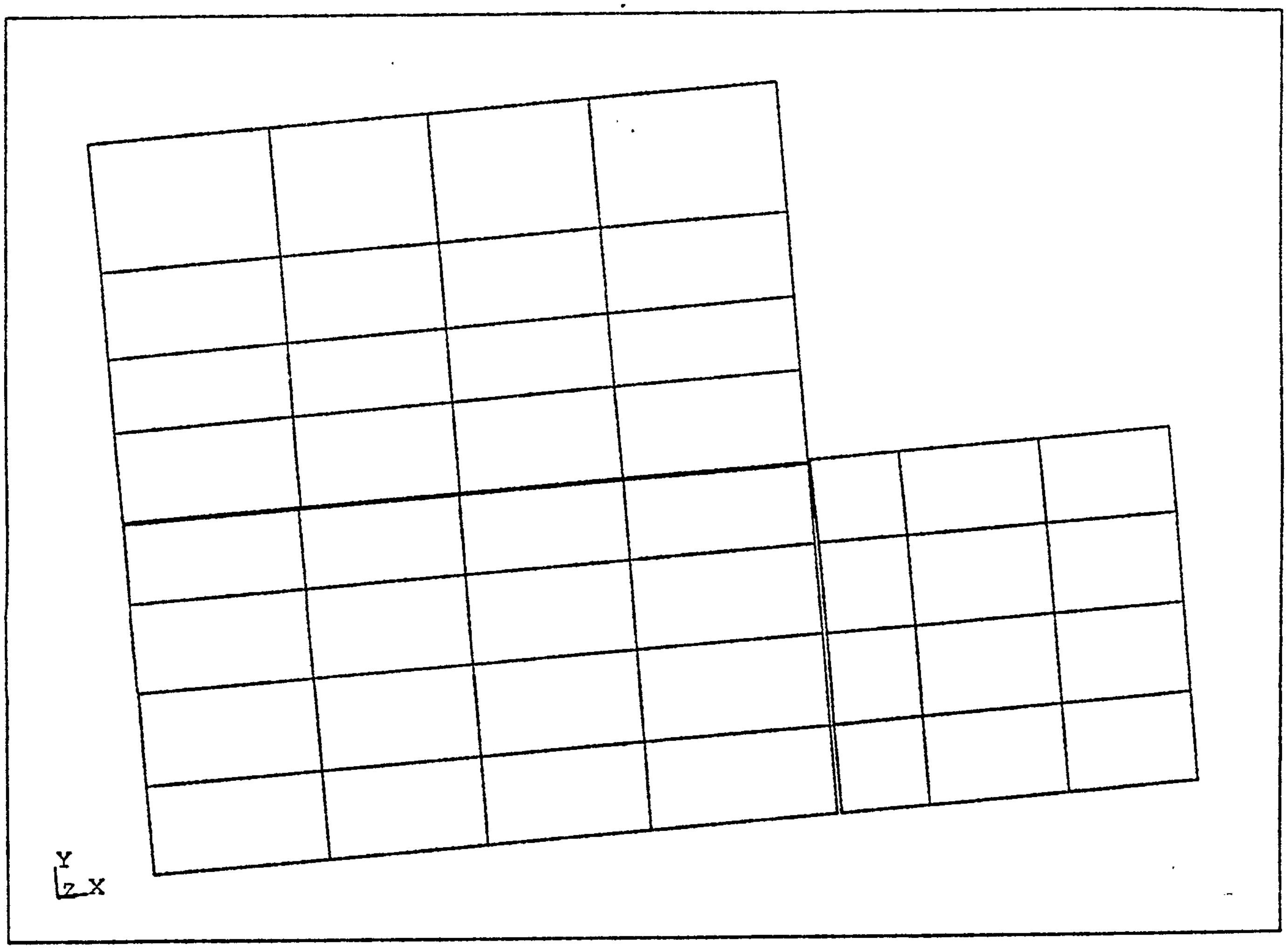


Figure 13.4: A Plot Of The Gridded Tranverse Bulkhead

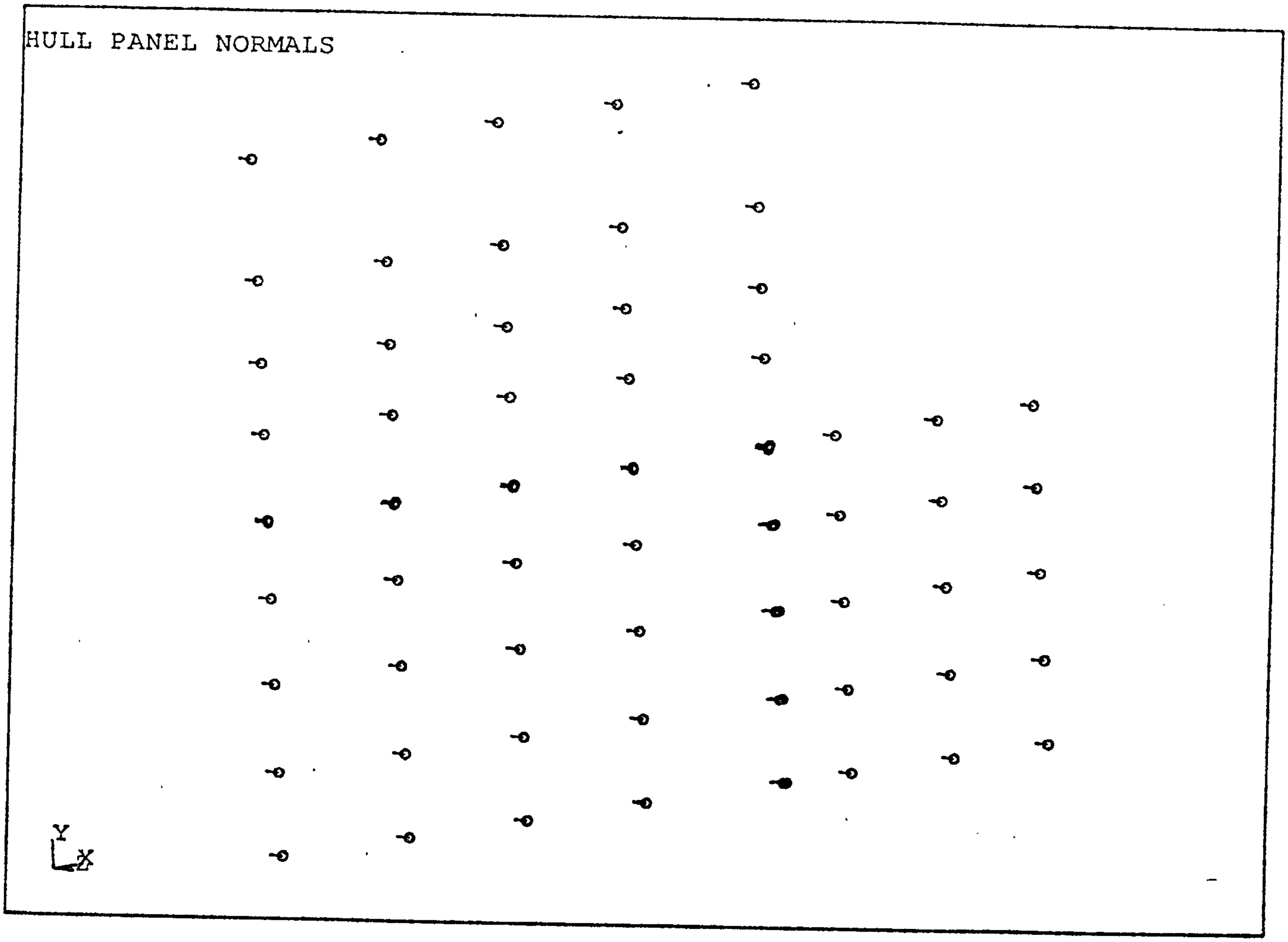


Figure 13.5: A Plot Of The Panel Normals

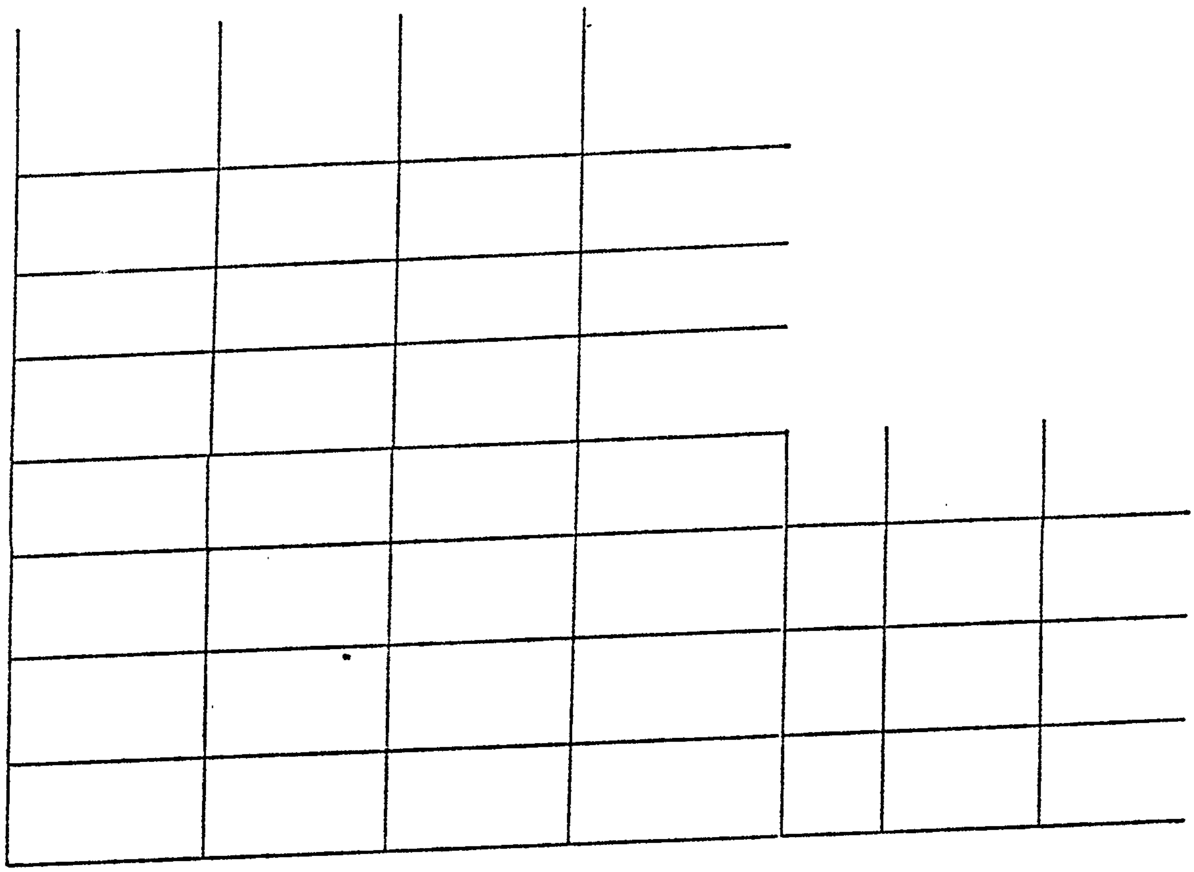


Figure 13.6: A Plot Of The Beam Grid On The Tranverse Bulkhead

Chapter 14

Option 10 Generation Of PATRAN Model

A PATRAN model of the hull based on panel coordinates can be generated by this Option. SHPHUL produces the model in the form of a session file which can read by PATRAN. It can then be displayed using PATRAN graphics.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
```

```
10

ENTER THE NUMBERS OF THE FIRST AND LAST SECTIONS TO BE
MODELLED AS A PHASE 1 PATRAN MODEL
6 6

READING FILE FRAME.D06
PROCESSING SECTION  6
PATRAN SESSION FILE IS SHIPM.SES
```

The session file is in a form to be read by directly by PATRAN. The model can be plotted by PATRAN by responding to the following prompts.

```
ENTER DEVICE MNEMONIC,"?",OR STOP
4211   is the device name in this case

INPUT"GO","SES","HELP",PATRAN EXECUTIVE DIRECTIVE OR"STOP".
SES
PLEASE INPUT THE NAME OF THE SESSION FILE (EG. MODEL.SES)
SHIPM.SES
```

The result of the PATRAN processing of hull section 6 is shown in Figure 14.1. Bells during the PATRAN processing indicate that the allowable number of patches set within PATRAN has been exceeded. A PATRAN model of the first 5 hull sections can be generated as follows.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
```

```
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
10

ENTER THE NUMBERS OF THE FIRST AND LAST SECTIONS TO BE
MODELLED AS A PHASE 1 PATRAN MODEL
1 6
READING FILE FRAME.D01
PROCESSING SECTION  1
  |  |  |  |  |  |  |
READING FILE FRAME.D05
PROCESSING SECTION  5

PATRAN SESSION FILE IS SHIPM.SES
```

The PATRAN display resulting from this session file is shown in Figure 14.2.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
```

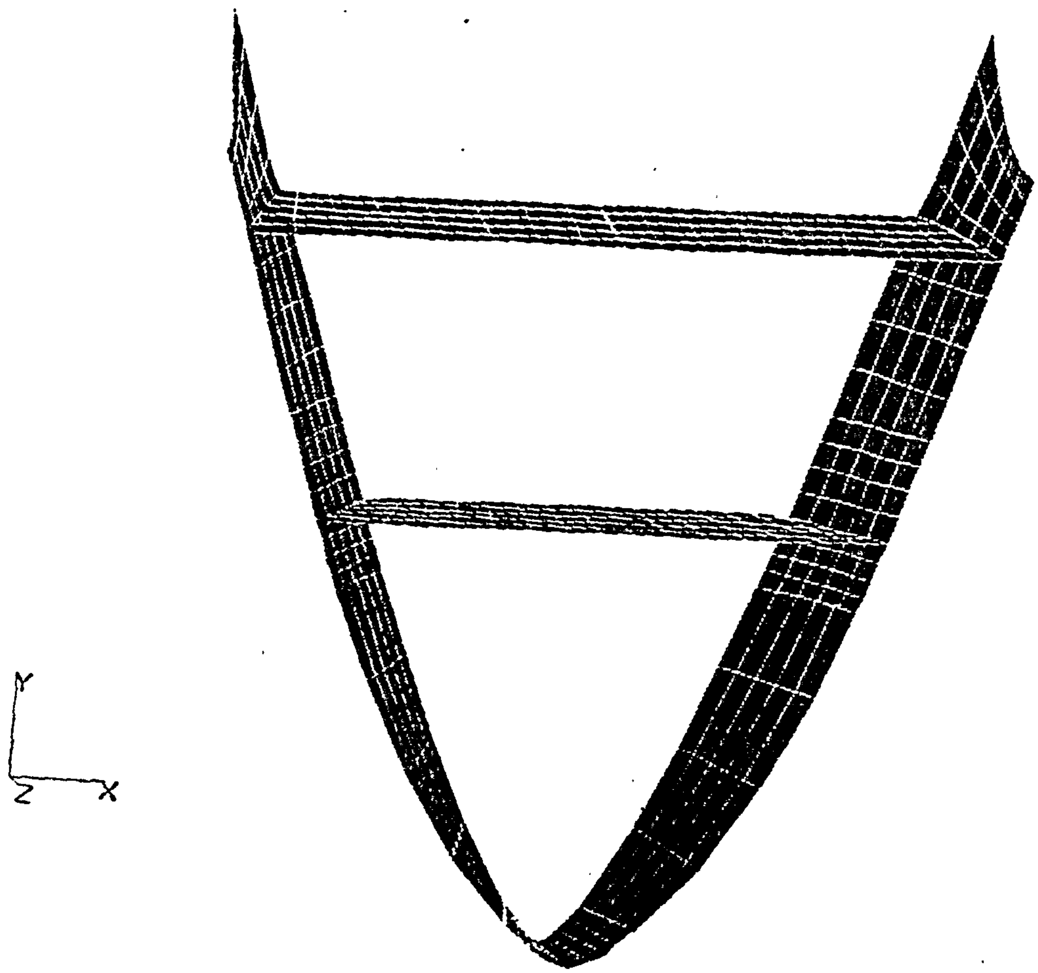


Figure 14.1: PATRAN Plot Of Hull Section 6

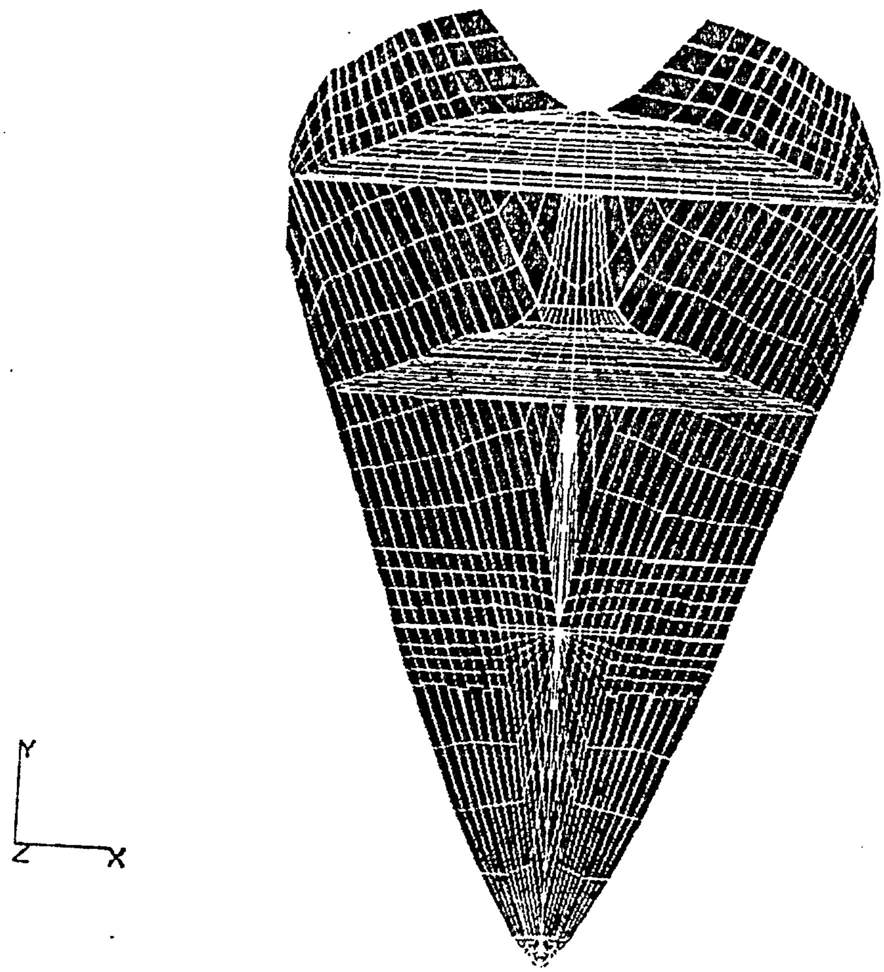


Figure 14.2: PATRAN Plot Of Hull Sections 1 To 6

Chapter 15

Option 11 Create VAST Geometry Files Of Hull Sections For Substructuring

When large models are run on small computers it will be necessary to use substructuring to obtain a solution. SHPHUL will create substructures of each section. Each gridded panel of a section will form a substructure and a geometry file SXXXX.GOM will be created for it where XXXX is the section number and the substructure number. For example S0304 refers to panel 4 of section 3. A list of the substructure names is also created as SHPHL.DAT for use by the program UNITE in merging the files into a assembly of substructures. See section 3.3 in Chapter 3 and Appendix F.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
```

```
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
11

ENTER THE NUMBER OF THE FIRST AND LAST SECTION TO BE SUBSTRUCTURED
1 10
READING FILE FRAME.D01
PROCESSING SECTION  1
CHOOSE TYPE OF PLATE ELEMENT
4 = 4 NODE QUAD
3 = 3 NODE TRIANGLE
4
CHOOSE FROM FOLLOWING
0 = MODEL AS A SINGLE STRUCTURE
1 = MODEL AS 2 LEVEL SUBSTRUCTURE
2 = CREATE SUBSTRUCTURED MODEL USING UNITE
2
GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  1
READING FILE FRAME.D02
PROCESSING SECTION  2
GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  2
READING FILE FRAME.D03
PROCESSING SECTION  3
GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  3
READING FILE FRAME.D04
PROCESSING SECTION  4
GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  4
READING FILE FRAME.D05
PROCESSING SECTION  5
GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  5
READING FILE FRAME.D06
PROCESSING SECTION  6
GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  6
READING FILE FRAME.D07
PROCESSING SECTION  7
GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  7
```

```
READING FILE FRAME.D08
PROCESSING SECTION  8
GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  8
READING FILE FRAME.D09
PROCESSING SECTION  9
GENERATING SHPHL.DAT AND GEOMETRY FILES FOR HULL SECTION  9

 The substructure files have been generated and are stored as SXXXX.GOM
files. A list of these files is found on SHPHL.DAT.

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16

FORTRAN STOP
```

To assemble these files into a substructure geometry file SHSUB.GOM and create a superelement master node file SHSUB.SED the program UNITE must be run. The program is a part of the VASFEM[7] suite of programs. The following is a demonstration of its use.

```
 VASFEM

*********************************************************
*                                                       *
```

```
*  V     V    AAA     SSSSS    FFFFFFF EEEEEE  M     M  *
*  V     V   A   A   S     S   F       E       MM   MM  *
*  V     V  A     A  S         F       E       M M M M  *
*  V     V  AAAAAAA   SSSSS    FFFF    EEEE    M  M  M  *
*  V     V  A     A        S   F       E       M     M  *
*   V   V   A     A  S     S   F       E       M     M  *
*    VVV    A     A   SSSSS    F       EEEEEE  M     M  *
*                                                       *
*  DEVELOPED BY MARTEC LTD. OF HALIFAX NOVA SCOTIA      *
*  FOR THE DEFENCE RESEARCH ESTABLISHMENT ATLANTIC      *
*                                                       *
*  VASFEM VERSION #01.00        MAY 1989                *
*.                                                      *
*********************************************************


VASFEM CREATES OR MODIFIES A VAST FINITE ELEMENT MODEL,
ITS BOUNDARY CONDITIONS AND LOADS.



WHAT IS THE LINE SPEED?
9600

IDENTIFY TERMINAL TYPE ACCORDING TO RESOLUTION,
CURSOR AND COLOUR CAPABILITY:
ENTER 0 FOR TEKTRONIX 4006 (LOW RES/NO CURS/NO COL)
      1 FOR TEKTRONIX 4010/12/13 (LOW RES/CURSORS/NO COL)
      2 FOR TEKTRONIX 4014/4015  (HI RES/CURSORS/NO COL)
      3 FOR TEKTRONIX 41XX/42XX OR 4014/4015-EGM (COLOUR)
2

IDENTIFY TERMINAL TYPE ACCORDING TO DIALOG CAPABILITY:
ENTER 0 NO DIALOG AREA
      1 DIALOG AREA

0
ENTER 5 CHARACTER PREFIX NAME FOR JOB AND DATA FILES.
SHPHL
```

SHPHL was created by SHPHUL and contains the data required by UNITE.

```
SPECIFY LENGTH UNITS USED IN THIS ANALYSIS;
(FOR UNITS:  NIL IN. FT. MM.  M.
     ENTER:   0   1   2   3   4 ):
1
SPECIFY FORCE UNITS USED IN THIS ANALYSIS;
(FOR UNITS:  NIL LBS.  KIPS.   N.   KN.   MN.
     ENTER:   0    1     2     3     4     5 ):
1
ENTER:  T TO TERMINATE THE PROGRAM
        R TO REDEFINE THE PREFIXES
        L TO LIST AVAILABLE OPTIONS
        C TO SELECT DESIRED OPTION.
C
ENTER DESIRED OPTION NUMBER.
14

SUBPROGRAM UNITE: PROGRAM TO ASSEMBLE A SUBSTRUCTURE COMPOSED
                  OF PREVIOUSLY GENERATED STRUCTURES WITH THE
                  SAME ORIGIN AND COORDINATE SYSTEM.


THE FILE SHPHL.DAT ALREADY EXISTS. DO YOU WISH TO REVIEW THE
CONTENTS OF THIS FILE (0=NO, 1=YES):
0

THE SHPHL.DAT  FILE ALREADY EXISTS.
DO YOU WISH TO OVERWRITE THIS FILE (0=NO, 1=YES):
0

PROGRAM RUNNING ------

SHSUB.GOM/SED AND SESSION DATA FILE HAVE BEEN CREATED

ENTER T TO TERMINATE THE PROGRAM
      R TO REDEFINE PREFIXES
      L TO LIST AVAILABLE OPTIONS
```

```
      C TO SELSECT DESIRED OPTION
T

FORTRAN STOP
```

At this stage the model can be plotted with VASTG using the prefix SHSUB.

Chapter 16

Option 12 Create Individual Section Model VAST Geometry Files

This option will create a series of individual section VAST.GOM files under the names SHPXX.GOM. In creating the files adjacent panel nodes are equivalenced based on a tolerance specified in subroutine EQUIV. If the distance between adjacent nodes is too great the nodes will not be matched. It is generally good practice to examine the assembled panels by plotting the section geometry files with VASTG6 to look for duplicate nodes. If duplicate nodes are found indicating a non equivalence it will be necessary to go back to editing the section panels under Option 3 and place the non equivalenced nodes closer together.

The SHPXX.GOM files may used for individual section analysis or may be assembled to form one single file under a user chosen PREFX by the use of the program VASGEN[5]. VASGEN is one of a suite of programs held by the program VASFEM[7]. The choice of option 12 produces the following prompts.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
```

```
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
12

ENTER THE NUMBER OF THE FIRST AND LAST SECTION TO BE
MODELLED AS INDIVIDUAL STRUCTURES
1 8

READING FILE FRAME.D01

PROCESSING SECTION  1
CHOOSE TYPE OF PLATE ELEMENT
4 = 4 NODE QUAD
3 = 3 NODE TRIANGLE
4

READING FILE FRAME.D02
PROCESSING SECTION  2
READING FILE FRAME.D03
PROCESSING SECTION  3
READING FILE FRAME.D04
PROCESSING SECTION  4
READING FILE FRAME.D05
PROCESSING SECTION  5
READING FILE FRAME.D06
PROCESSING SECTION  6
READING FILE FRAME.D07
PROCESSING SECTION  7
READING FILE FRAME.D08
PROCESSING SECTION  8

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
```

```
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
FORTRAN STOP
```

Chapter 17

Option 13 Create Repeating Section Geometry Files

Some ship hulls such as tankers have sections that are repeated. Modelling time can saved by repeating the sections at the basic data level of FRAME.DXX by selecting option 13 in the SHPHUL menu. The repeated sections can then be converted to individual section VAST geometry files using option 12 or substructured using option 11. The individual repeated sections can be merged into one large structure using the VASGEN or in the case of substructuring by using option 14 in VASFEM. Choosing option 13 in SHPHUL produces the following prompts.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
```

```
15 = PLOT VAST GEOMETRY FILES
16 = STOP
13

A SECTION MAY BE REPEATED AS INDIVIDUAL SECTION
PANEL FILES
ENTER THE NUMBER OF THE SECTION TO BE REPEATED
40

ENTER THE NUMBERS OF THE FIRST AND LAST SECTION TO BE
GENERATED FROM SECTION  40
41 43

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
16
```

The generated sections can be plotted for inspection with option 2 before choosing option 11 or 12 to merge them into a larger structure.

Chapter 18

Option 14 Create Added Mass File For Assembled Sections

To account for the effect of the surrounding water on the vibration frequencies of a ship hull it is necessary to include the water as part of the model in the form of an added mass. The water can be modelled using any of three methods; the surface panel method, the infinite fluid finite element, or the fluid finite element. These modelling options are available in SHPHUL to produce the required VAST compatible added mass file, PREFX.AMD, for a vibration analysis.

18.1 Surface Panel Method

A detailed description of the surface panel method can be found in reference [9]. It has the advantage of economy as the fluid effect is modelled by panels which match the submerged hull plate elements in number and size. The panels are quadrilaterals and cannot be applied to a surface modelled with triangular elements.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
```

```
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
14

SELECT FLUID ADDED MASS MODELLING METHOD
 1 = SURFACE PANEL METHOD
 2 = INFINITE FLUID FINITE ELEMENT METHOD
 3 = FLUID FINITE ELEMENT METHOD
1

ENTER A TITLE FOR THE MODEL (MAX 72 CHARACTERS)
 Test of the Surface Panel Method

SELECT HULL COMPONENTS TO BE IMMERSED
1 = SIDES
2 = BULKHEADS
3 = DECKS
1

ENTER THE RANGE OF THE SECTIONS ASSEMBLED
78 88
```

The range of VAST geometry files of the sections which have been assembled to create the hull must be entered so as to identify the components such as sides.

```
READING FILE SHP78
READING FILE SHP79
READING FILE SHP80
READING FILE SHP81
READING FILE SHP82
READING FILE SHP83
READING FILE SHP84
```

```
READING FILE SHP85
READING FILE SHP86
READING FILE SHP87
READING FILE SHP88

ENTER THE 5 CHARACTER PREFIX OF THE GEOMETRY FILE NAME
OF THE ASSEMBLED MODEL)
SHPTA
```

The five character name of the assembled ship hull VAST geometry file must be entered.

```
READING FILE SHPAS.GOM

CHOOSE IMMERSED WATERLINE
0 = STILL WATERLINE
1 = BALANCE ON A WAVE
0
```

The balance-on-a-wave waterline can be used if a wave profile PROFL.DAT generated by the program POSBOW is available. See the section on Assembled Section Loads in Chapter 6 for more information on this option.

```
ENTER WATERLINE HEIGHT IF KNOWN OTHERWISE ENTER 0
TO CONTINUE
130
```

The waterline height must be in the units used in the model creation.

```
 FOR BETTER PANEL DEFINITION IN THE HULL PLOT
ENTER VERTICAL SCALE MULTIPLIER
1.5
```

The model when plotted may have such a dense grid that a water line may be hard to distinguish. Increasing the vertical scale improves the ability to define the line through the elements.

```
WINDOW THE IMMERSED AREA ON THE FOLLOWING PLOT
BOTTOM LEFT AND TOP RIGHT
```

```
PRESS R FOR RETURN
R
```

The plot of the hull and waterline are shown in Figure 18.1. If the given waterline cuts across element levels it may be necessary to adjust it with the cursor as shown. Better planning in the hull model generation can produce a grid more likely to match the waterline.

```
ENTER THE NUMBER CORRESPONDING TO FLUID DENSITY
1 = SEA WATER IN METRIC UNITS N.sec**2/mm**4 .000000001028
2 = SEA WATER IN IMPERIAL UNITS lbs.sec**2/in**4 .000098
3 = USER SELECTED UNITS
2

ENTER
0 TO CONTINUE
1 TO PLOT FLUID PANEL MODEL
1

ENTER THE ANGLES OF ROTATION ABOUT X Y Z AXES
TO DISPLAY MODEL FOR PANEL SUBMERGENCE
10 10 10

ENTER
0 TO CONTINUE
1 TO PLOT FLUID PANEL MODEL
0
```

The surface panel model is shown plotted in Figure 18.2

```
ADDED MASS FILE SHPTA.AMD HAS BEEN CREATED
ENTER 0 TO CONTINUE
```

18.2 Infinite Fluid Finite Element Method

The Infinite fluid finite element method is described in reference[10] and the VAST users manual reference 1 page D-1 and D-6. It is based on decreasing the effect of the added mass using a decay function. The function chosen for SHPHUL is exponential type

$$[e^{-r}] \tag{18.1}$$

where r is the radius from the decay origin.

The attenuation of the decay function is based on (waterline height + half width)/(half width)

There are three element types used for infinite element modelling. Type 1 are interface elements used to connect structural nodes to fluid nodes. They are four noded quadrilaterals and match the surface of the hull shell where they are applied. Type 2 are regular 8 node fluid brick elements which form the first layer and are attached to the hull shell by the interface elements. Type 5 form the outer layer and are the 8 node infinite fluid brick elements. The element types can be plotted separately or together, if required for inspection, using VASTG.

```
SELECT FLUID ADDED MASS MODELLING METHOD
 1 = SURFACE PANEL METHOD
 2 = INFINITE FLUID FINITE ELEMENT METHOD
 3 = FLUID FINITE ELEMENT METHOD
 2

ENTER A TITLE FOR THE MODEL (MAX 72 CHARACTERS)
Test of Infinite Element Modelling

SELECT HULL COMPONENTS TO BE IMMERSED
1 = SIDES
2 = BULKHEADS
2 = DECKS
1

ENTER THE RANGE OF THE SECTIONS ASSEMBLED
78 88
```

The range of VAST geometry files of the sections which have been assembled to create the hull must be entered so as to identify the components such as sides.

```
READING FILE SHP78
READING FILE SHP79
READING FILE SHP80
READING FILE SHP81
READING FILE SHP82
```

```
READING FILE SHP83
READING FILE SHP84
READING FILE SHP85
READING FILE SHP86
READING FILE SHP87
READING FILE SHP88

ENTER THE 5 CHARACTER PREFX OF THE GEOMETRY FILE NAME
OF THE ASSEMBLED MODEL)
SHPTA

READING FILE SHPTA.GOM

ENTER WATERLINE HEIGHT IF KNOWN OTHERWISE ENTER 0
TO CONTINUE
130
```

The waterline height must be in the units used in the model creation.

```
FOR BETTER PANEL DEFINITION IN THE HULL PLOT
ENTER VERTICAL SCALE MULTIPLIER
1.5

WINDOW THE IMMERSED AREA ON THE FOLLOWING PLOT
BOTTOM LEFT AND TOP RIGHT
PRESS R FOR RETURN
R
```

The plot of the hull and waterline are shown in Figure 18.1. If the given waterline cuts accross element levels it may be necessary to adjust it with the cursor as shown. Better planning in the hull model generation can produce a grid more likely to match the waterline.

```
ENTER THE NUMBER CORRESPONDING TO FLUID DENSITY
1 = SEA WATER IN METRIC UNITS N.sec**2/mm**4 .000000001028
2 = SEA WATER IN IMPERIAL UNITS lbs.sec**2/in**4 .000098
3 = USER SELECTED UNITS
2
```

```
ENTER THE TWO FACTORS FOR MULTIPLYING THE WATER
LINE HEIGHT 133.46 TO SET THE INFINITE FLUID LAYER DEPTHS
OR ENTER D TO SET DEFAULT FACTORS 1.0 AND 2.0
D

WINDOW THE WATERLINE ON THE FOLLOWING PLOT
BOTTOM LEFT AND TOP RIGHT
PRESS R FOR RETURN
R
```

The hull shell structure below the waterline is displayed for confirmation and the cursor is used to finally define the waterline as shown in Figure 18.3.

```
WRITING ADDED MASS FILE SPHTA.AMD NUMBER OF NODES= 2556
```

A plot of the infinite fluid element model, produced using VASTG, is shown in Figure 18.4.

18.3 Fluid Finite Element Method

A detailed description of the fluid finite element method is given in reference[11] . Up to five fluid layers can be processed by VAST. The program SHPHUL generates only three layers as experience has shown they give reasonable results with considerable saving in model size. Two types of elements are used for this modelling method. They are type 1 which are four node interface elements, joining structure to fluid, and type 2 which are eight node brick fluid elements forming the three fluid layers.

```
SELECT FLUID ADDED MASS MODELLING METHOD
 1 = SURFACE PANEL METHOD
 2 = INFINITE FLUID FINITE ELEMENT METHOD
 3 = FLUID FINITE ELEMENT METHOD
 2

ENTER A TITLE FOR THE MODEL (MAX 72 CHARACTERS)
Test Of Fluid Finite Element Modelling

SELECT HULL COMPONENTS TO BE IMMERSED
1 = SIDES
```

```
2 = BULKHEADS
2 = DECKS
1

ENTER THE RANGE OF THE SECTIONS ASSEMBLED
78 88
```

The range of VAST geometry files of the sections which have been assembled to create the hull must be entered so as to identify the components such as sides.

```
READING FILE SHP78
READING FILE SHP79
READING FILE SHP80
READING FILE SHP81
READING FILE SHP82
READING FILE SHP83
READING FILE SHP84
READING FILE SHP85
READING FILE SHP86
READING FILE SHP87
READING FILE SHP88

ENTER THE 5 CHARACTER PREFIX OF THE GEOMETRY FILE NAME
OF THE ASSEMBLED MODEL)
SHPTA

READING FILE SHPTA.GOM

ENTER WATERLINE HEIGHT IF KNOWN OTHERWISE ENTER 0
TO CONTINUE
130
```

The waterline height must be in the units used in the model creation.

```
FOR BETTER PANEL DEFINITION IN THE HULL PLOT
ENTER VERTICAL SCALE MULTIPLIER
1.5

WINDOW THE IMMERSED AREA ON THE FOLLOWING PLOT
```

```
R
```

The plot of the hull and waterline are shown in Figure 18.1. If the given waterline cuts accross element levels it may be necessary to adjust it with the cursor as shown. Better planning in the hull model generation can produce a grid more likely to match the waterline.

```
ENTER THE NUMBER CORRESPONDING TO FLUID DENSITY
1 = SEA WATER IN METRIC UNITS N.sec**2/mm**4 .000000001028
2 = SEA WATER IN IMPERIAL UNITS lbs.sec**2/in**4 .000098
3 = USER SELECTED UNITS
2

ENTER THE THREE FACTORS FOR MULTIPLYING THE WATER
LINE HEIGHT 133.46 TO SET THE THREE FLUID LAYER DEPTHS
OR ENTER D TO SET DEFAULT FACTORS 1.0 2.0 AND 3.0
D
```

The layer depths are multiples of the waterline height added to the local hull surface.

```
WINDOW THE WATERLINE ON THE FOLLOWING PLOT
BOTTOM LEFT AND TOP RIGHT
PRESS R FOR RETURN
R
```

The hull shell structure below the waterline is displayed for confirmation and the cursor is used to finally define the waterline as shown in Figure 18.3.

```
WRITING ADDED MASS FILE SPHTA.AMD NUMBER OF NODES= 3408
```

A plot of the fluid element model, produced using VASTG, is shown in Figure 18.5.

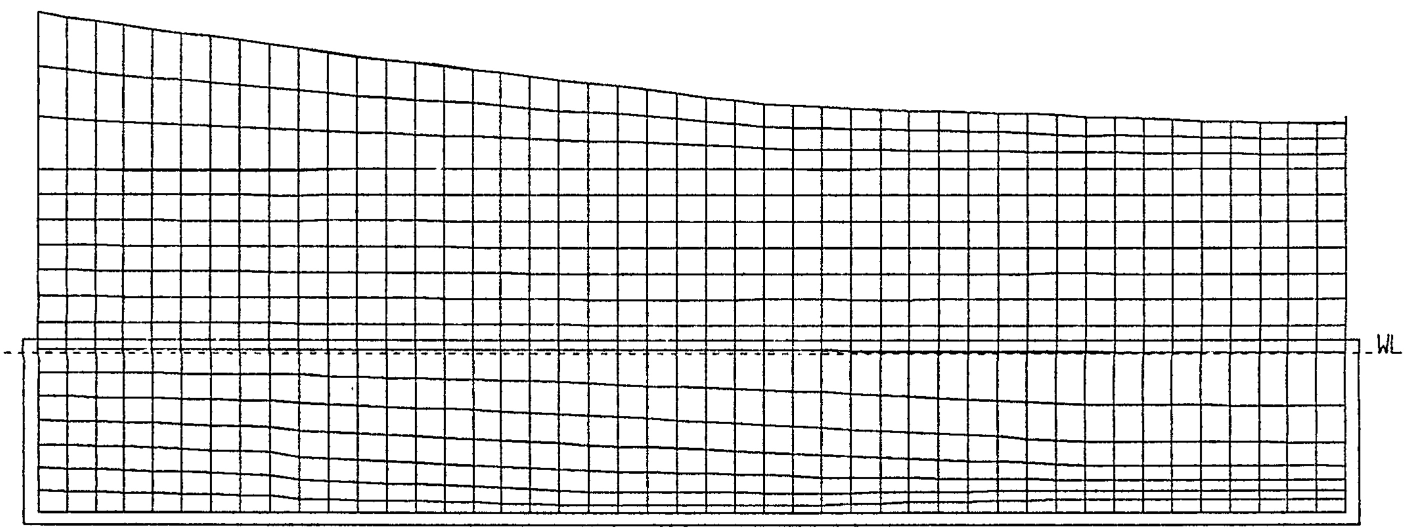


Figure 18.1: Hull Model With Submerged Portion Of Hull And Waterline Identified

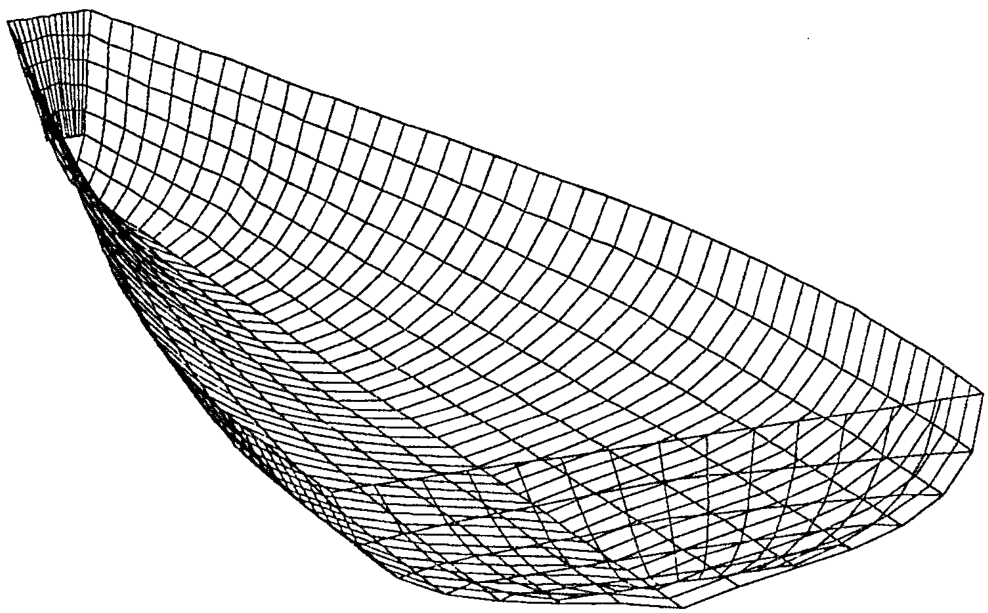


Figure 18.2: Surface Panels On Submerged Portion Of Hull

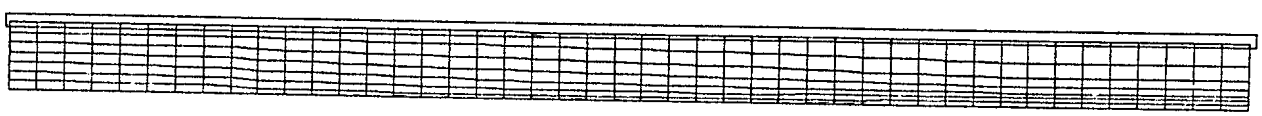


Figure 18.3: Submerged Portion Of Hull With Waterline Windowed

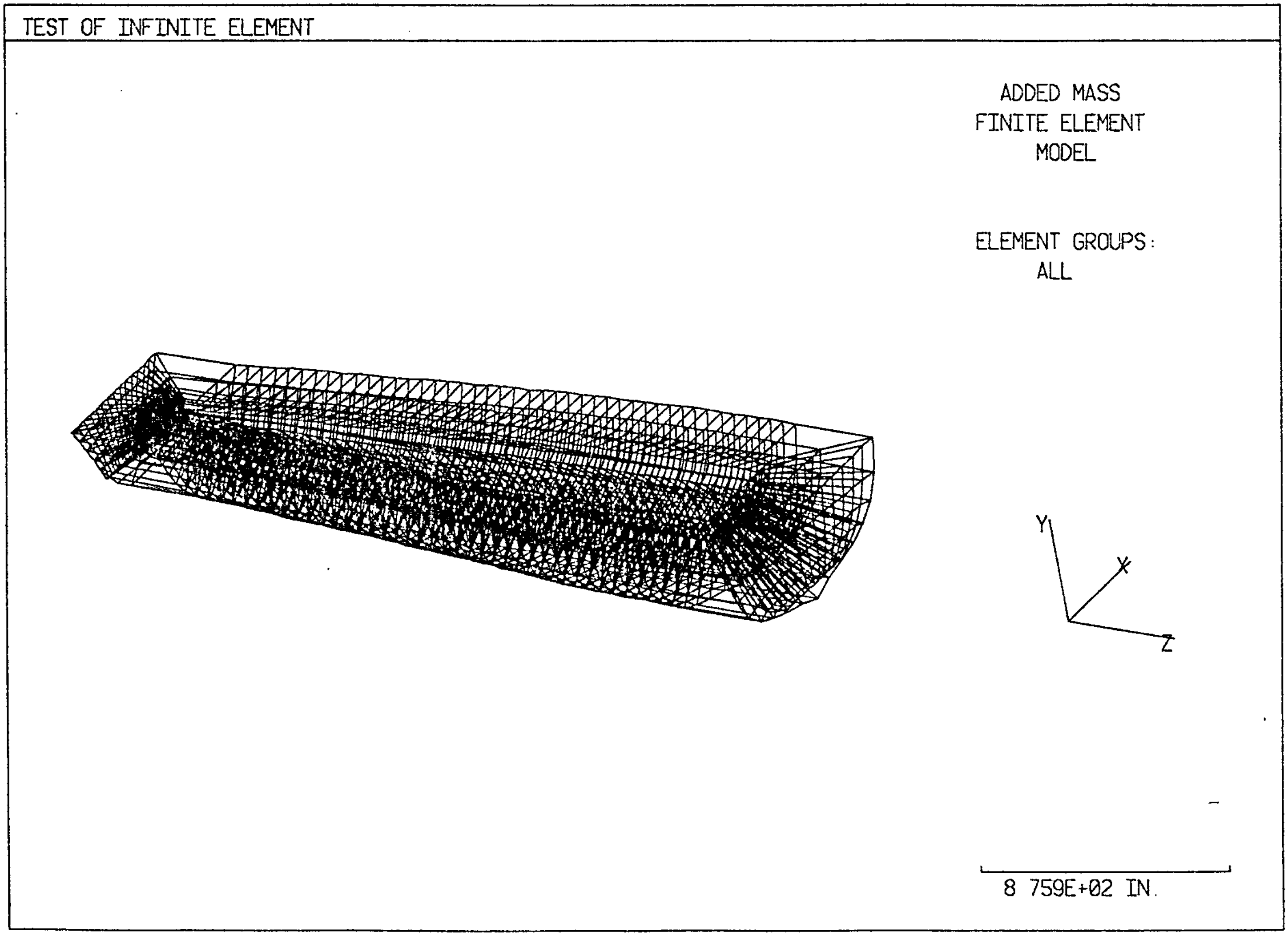


Figure 18.4: Infinite Fluid Element Model

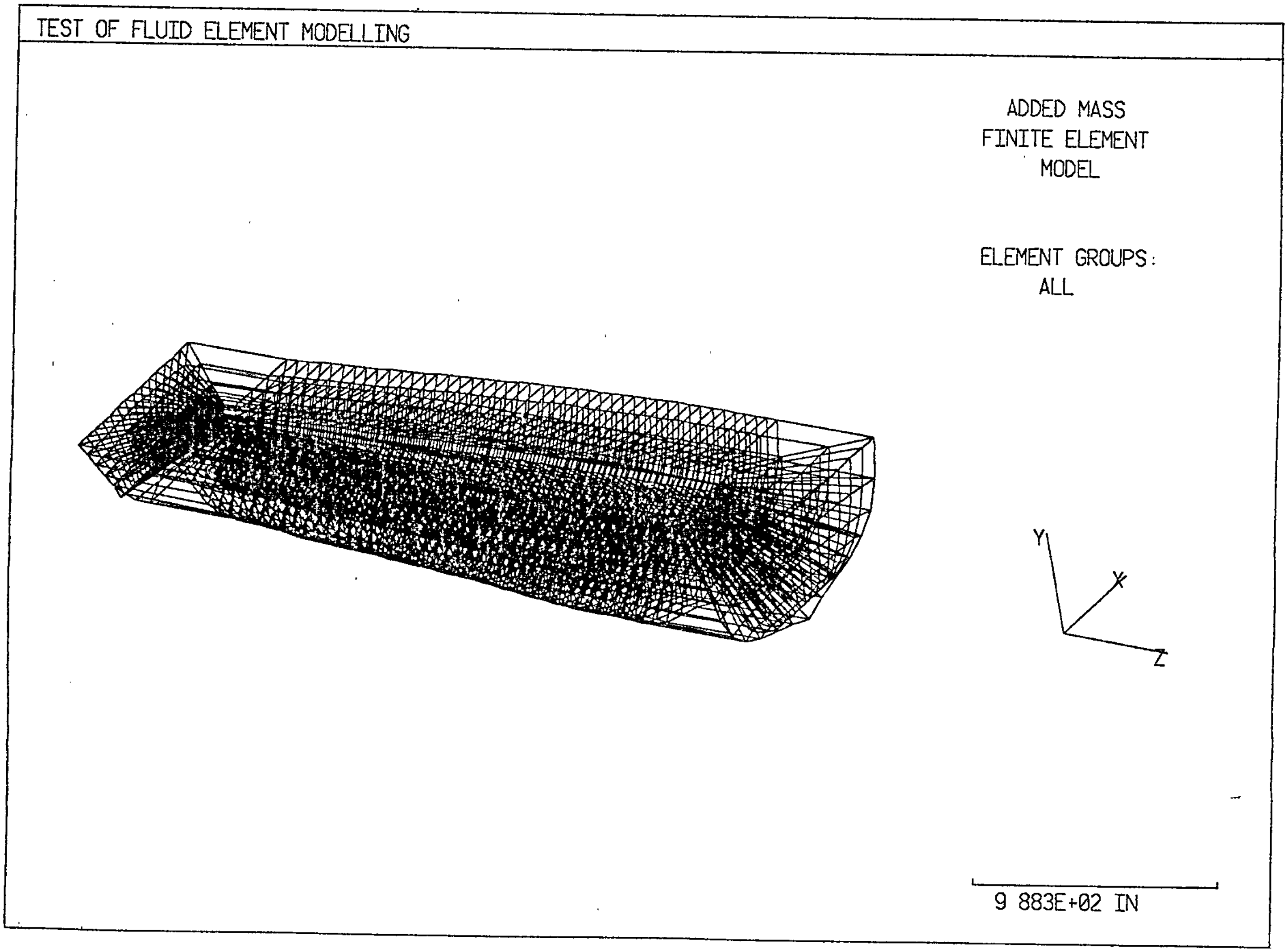


Figure 18.5: Fluid Finite Element Model

Chapter 19

Option 15 Plot VAST Geometry Files

The ability to plot VAST finite element geometry files, created by SHPHUL, has been provided as Option 15. The plate element grid as well as the beam grid can be viewed. The file to be plotted is stored as PREFX.GOM where PREFX is the name assigned to the file. If the model is a section then the file name will be SHPXX.GOM where XX is the section number. If it is a file of assembled sections then the PREFX is that assigned during the assembly procedure. The assembly of sections is performed by the use of the program VASGEN as described in reference 4. The files can also be plotted using the VAST auxiliary plotting program VASTG. An example of the use of option 15 is illustrated in the following terminal session.

```
CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
```

```
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
15

ENTER THE AXIS DESIRED FOR THE LENGTH OF THE HULL
Z
```

In this case the Z axis was used as the length axis when the model was generated.

```
ENTER THE FIVE CHARACTER PREFIX FOR THE
VAST GEOMETRY FILE TO BE PLOTTED
SHPBM
```

The model chosen was formed by assembling a series of section geometry files into one large model.

```
VAST GEOMETRY FILE SHPBM.GOM  EXIST
 0 CONTINUE AND PLOT FILE
 2 RETURN TO MAIN MENU
0

ENTER
 0 TO LABEL NODES WITH CURSOR
 1 TO PRINT NODE NUMBERS
0

ENTER
 0 TO PLOT PLATES
 1 TO PLOT BEAMS
0

ENTER THE ANGLES OF ROTATION ABOUT X Y Z AXES TO DISPLAY MODEL
45 45 45

 AFTER PLOTTING ENTER
 W TO WINDOW
 E TO END
```

```
 L TO LABEL NODES
 ENTER 0 TO CONTINUE
0
```

The model, which is a half model, is shown plotted in Figure 19.1. At this stage the finite element model can be windowed to enlarge a portion of the view by entering W. This will cause the cursor to appear and the area to be enlarged can be outline by locating the lower left and the upper right corners of the window. The entry of L will allow the node numbers to be identified with the cursor. The entry of E causes the following prompt to appear.

```
VAST GEOMETRY FILE SHPBM.GOM  EXIST
 0 CONTINUE AND PLOT FILE
 2 RETURN TO MAIN MENU
2

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT A SECTION, BEAM NORMALS, CHECK FOR DUPLICATE BEAMS
     GENERATE LOADS OR BOUNDARY CONDITIONS
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = CREATE REPEATING SECTION GEOMETRY FILES
14 = CREATE ADDED FLUID MASS FILE FOR ASSEMBLED SECTIONS
15 = PLOT VAST GEOMETRY FILES
16 = STOP
16
```

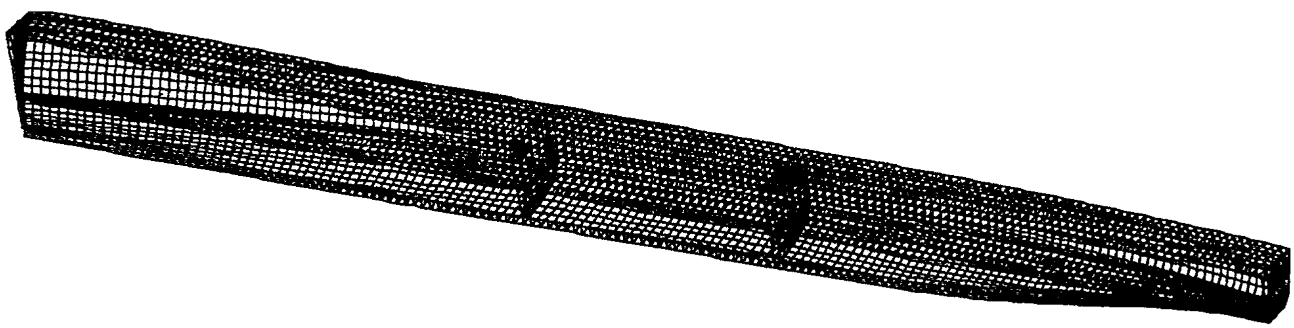


Figure 19.1: Plot Of An Assembled Half Model

Appendix A

Body Plan Offsets

Format 1 for bodyplan offset data.

```
265 HULL OFFSETS                Title
   356.00 ft.                   Overall length  Units   F10.2,1X,A
 1 12  1                        Station number, number of offsets, dummy character
  0.0  0.46  1.19  1.82  2.33  2.57  2.84  3.50  4.50  6.55  9.25 12.79    X
  0.0  0.00  2.77  6.60  9.93 11.21 12.61 15.53 18.84 23.84 28.78 34.01    Y
 2 12  1
  0.0  0.49  1.60  2.76  3.61  4.49  5.04  6.56  8.32 11.19 13.65 15.57
  0.0  0.0  1.44  3.62  5.96  8.70 10.56 15.05 19.40 25.42 29.81 32.65
 3 12  1
  0.0  0.49  3.07  4.55  5.77  6.90  8.24  9.58 11.19 13.40 15.19 17.16
  0.0  0.0  2.01  3.69  6.06  8.49 11.76 14.97 18.87 23.68 27.30 31.40
 4 12  1
  0.0  0.49  3.79  6.43  8.75 10.19 11.53 12.72 14.00 15.38 16.92 18.09
  0.0  0.0  1.54  3.86  7.13  9.97 12.77 15.58 18.86 22.32 26.88 30.34
 5 12  1
  0.0  0.55  4.59  8.68 11.01 12.75 14.52 16.01 16.37 17.33 17.92 18.93
  0.0  0.0  1.30  4.18  6.86  9.76 13.47 17.34 18.82 22.12 25.01 29.30
 6 12  1
  0.0  0.52  7.18 11.60 14.70 15.80 16.62 17.90 18.25 18.81 19.24 19.65
  0.0  0.0  1.93  4.94  8.78 10.59 12.55 16.66 18.65 21.67 25.21 28.14
 7 12  0
  0.0  0.52  8.78 12.59 15.29 17.10 18.14 19.11 19.64 20.06 20.22 20.27
  0.0  0.0  2.10  4.01  6.39  9.04 11.22 14.52 18.60 23.83 26.69 27.53
 8 12  0
  0.0  0.49  8.87 13.40 16.23 18.61 19.71 20.40 20.47 20.65 20.66 20.74
  0.0  0.0  1.91  3.46  5.27  8.46 11.66 15.12 18.49 22.64 25.47 27.16
 9 12  3
  0.0  0.49  8.90 14.66 17.43 19.36 20.39 20.84 20.99 20.94 20.92 20.94
```

```
 0.0  0.0  1.91  3.49  5.16  7.53 10.58 13.75 19.04 22.18 24.92 27.04
10 12  3
 0.0  0.46 12.67 16.51 18.66 19.73 20.51 20.87 21.00 20.97 20.92 20.94
 0.0  0.0  2.65  4.16  5.98  7.69 10.03 12.98 16.12 20.72 24.06 26.50
11 12  3
 0.0  0.43 12.67 16.39 18.53 19.54 20.36 20.77 20.97 20.94 20.92 20.94
 0.0  0.0  2.71  4.32  6.16  7.66 10.15 13.01 16.12 20.72 24.06 26.50
12 12  3
 0.0  0.43  9.90 14.33 17.40 18.87 20.08 20.62 20.91 20.91 20.92 20.91
 0.0  0.0  2.14  3.65  5.66  7.28  9.90 12.95 16.12 20.72 24.06 26.5
13 12  3
 0.0  0.43 11.53 14.72 16.69 18.74 19.68 20.41 20.81 20.85 20.86 20.85
 0.0  0.0  2.99  4.34  5.66  7.90  9.87 12.64 16.12 20.72 24.09 26.50
14 12  3
,0.0  0.40  9.56 13.95 17.48 18.76 19.68 20.28 20.60 20.76 20.77 20.75
 0.22  0.22  2.82  4.74  7.34  9.05 11.14 13.63 16.12 20.72 24.03 26.50
15 12  2
 0.0  0.40  8.36 14.56 16.95 18.51 19.39 20.02 20.26 20.48 20.46 20.45
 0.96  0.96  3.40  6.17  7.99 10.14 12.41 14.93 16.15 20.72 24.06 26.5
16 12  2
 0.0  0.51  8.41 11.21 14.58 16.45 17.89 19.16 19.40 19.68 19.75 19.80
 2.70  2.70  4.93  5.97  7.66  9.26 11.35 15.27 16.08 20.71 24.05 26.5
17 12  2
 0.00  0.46  7.66 12.55 14.85 16.35 17.02 17.41 18.10 18.60 18.77 18.84
 5.41  5.41  7.06  8.55  9.99 11.56 12.86 13.86 16.08 20.64 24.02 26.5
18 12  2
 0.0  0.38 10.20 12.26 13.55 14.62 15.38 15.78 16.32 17.00 17.38 17.64
 8.48  8.48 10.06 10.73 11.48 12.42 13.63 14.69 16.10 20.66 24.01 26.5
19 12  0
 0.0  6.56  8.93 10.22 11.33 11.97 12.61 13.25 13.82 14.88 15.59 16.10
10.66 10.75 10.89 11.37 12.02 12.65 13.59 14.83 16.08 20.65 24.00 26.5
20 12  0
 0.03  4.74  6.25  7.23  8.15  8.80  9.65 10.17 10.78 12.20 13.29 14.13
10.66 10.81 10.97 11.32 11.85 12.45 13.63 14.75 16.06 20.63 24.02
```

Format 2 for bodyplan offset data. Additional stations added for modelling purposes.

```
NAME:QUEST  Title
  2820.00 in.     Overall length Units   F10.2,1X,A
   -1.021  4  1    Multiplier, number of offsets, station number
    0.000     16.500    43.500    65.200
  429.900    434.100   459.300   482.600
   -0.851  6  2
    0.000     15.600    30.562    43.922    55.727    67.371
  388.076    395.950   412.448   428.946   445.444   475.942
```

-0.681 12 3						
0.000	0.135	2.958	7.365	8.884	17.993	29.093
40.135	51.138	61.973	72.612	82.519		
346.464	346.532	347.503	349.929	351.100	362.954	379.452
395.950	412.448	428.946	445.444	472.942		
-0.511 19 4						
0.000	7.007	7.886	17.291	25.045	25.116	25.307
25.519	25.560	26.097	27.445	28.098	34.790	44.303
54.270	64.859	74.415	83.342	92.355		
304.792	312.300	313.461	329.959	345.600	345.728	346.074
346.456	346.532	347.503	349.929	351.100	362.954	379.452
395.950	412.448	428.946	445.444	469.942		
-0.340 22 5						
0.000	0.296	7.406	14.335	20.356	20.819	28.075
36.217	36.287	36.478	36.688	36.730	37.266	38.617
39.272	45.997	55.529	65.282	74.608	83.706	92.639
103.081						
263.354	263.967	280.465	296.963	312.300	313.461	329.959
345.600	345.728	346.074	346.456	346.532	347.503	349.929
351.100	362.954	379.452	395.950	412.448	428.946	445.444
465.942						
-0.170 24 6						
0.000	2.368	6.826	11.543	16.645	22.685	29.358
29.894	37.921	46.211	46.282	46.472	46.683	46.725
47.262	48.612	49.265	55.906	65.218	74.608	84.166
93.687	102.293	108.731				
221.672	230.971	247.469	263.967	280.465	296.963	312.300
313.461	329.959	345.600	345.728	346.074	346.456	346.532
347.503	349.929	351.100	362.954	379.452	395.950	412.448
428.946	445.444	461.942				
0.000 26 7						
0.000	0.269	3.417	6.814	10.444	14.350	18.933
24.633	31.391	38.351	38.902	47.077	55.304	55.373
55.559	55.765	55.806	56.329	57.642	58.278	64.814
74.203	84.739	95.052	103.170	115.300		
180.000	181.477	197.975	214.473	230.971	247.469	263.967
280.465	296.963	312.300	313.461	329.959	345.600	345.728
346.074	346.456	346.532	347.503	349.929	351.100	362.954
379.452	395.950	412.448	428.946	460.444		
0.340 30 8						
0.000	1.774	4.287	6.939	9.715	12.600	15.773
19.417	23.659	28.571	34.155	40.486	47.654	54.950
55.518	63.850	72.248	72.319	72.512	72.726	72.768
73.315	74.704	75.384	82.508	92.342	101.033	109.009
116.313	124.728					
103.161	115.486	131.983	148.481	164.979	181.477	197.975
214.473	230.971	247.469	263.967	280.465	296.963	312.300

```
313.461   329.959   345.600   345.728   346.074   346.456   346.532
347.503   349.929   351.100   362.954   379.452   395.950   412.448
428.946   456.444
  0.681 32  9
  0.000     1.256     4.137     7.106    10.124    13.172    16.410
 19.858    23.484    27.402    31.853    36.860    42.447    48.644
 55.425    62.849    70.445    71.050    79.898    88.512    88.583
 88.776    88.989    89.031    89.573    90.929    91.584    98.341
108.922   119.229   126.406   137.441
 58.577    65.992    82.490    98.988   115.486   131.983   148.481
164.979   181.477   197.975   214.473   230.971   247.469   263.967
280.465   296.963   312.300   313.461   329.959   345.600   345.728
346.074   346.456   346.532   347.503   349.929   351.100   362.954
379.452   395.950   412.448   445.000
  1.021 35 10
  0.000     1.484     5.702     8.483    11.334    14.331    17.497
 20.896    24.598    28.723    33.248    38.559    44.224    50.564
 57.102    63.769    70.674    77.808    84.776    85.326    93.515
101.681   101.749   101.934   102.138   102.179   102.698   104.003
104.636   111.233   120.871   131.221   135.742   140.794   142.794
 29.087    32.996    49.494    65.992    82.490    98.988   115.486
131.983   148.481   164.979   181.477   197.975   214.473   230.971
247.469   263.967   280.465   296.963   312.300   313.461   329.959
345.600   345.728   346.074   346.456   346.532   347.503   349.929
351.100   362.954   379.452   395.950   408.448   428.946   440.444
  1.305 33 11
  0.000     4.775     9.849    13.588    17.297    20.720    24.450
 28.474    33.018    37.979    43.266    48.990    54.925    61.579
 68.237    75.033    81.929    89.547    96.350    96.883   104.849
112.963   113.032   113.219   113.425   113.466   113.993   115.322
115.971   122.838   132.452   142.251   152.993
 19.863    32.996    49.494    65.992    82.490    98.988   115.486
131.983   148.481   164.979   181.477   197.975   214.473   230.971
247.469   263.967   280.465   296.963   312.300   313.461   329.959
345.600   345.728   346.074   346.456   346.532   347.503   349.929
351.100   362.954   379.452   395.950   430.000
  1.589 34 12
  0.000     0.377     8.263    13.688    18.412    23.245    27.688
 32.371    37.289    42.749    48.420    54.180    60.095    66.038
 72.355    78.810    85.602    92.874   100.619   107.693   108.234
116.178   124.515   124.588   124.783   125.001   125.044   125.600
127.014   127.710   134.652   144.494   153.435   160.612
 16.341    16.498    32.996    49.494    65.992    82.490    98.988
115.486   131.983   148.481   164.979   181.477   197.975   214.473
230.971   247.469   263.967   280.465   296.963   312.300   313.461
329.959   345.600   345.728   346.074   346.456   346.532   347.503
349.929   351.100   362.954   379.452   395.950   410.419
```

1.872 33 13						
0.000	1.435	11.871	17.855	23.683	29.259	35.086
41.059	47.128	53.098	59.167	65.218	71.238	77.172
83.246	89.612	96.387	103.845	111.661	118.979	119.531
127.502	134.780	134.854	135.053	135.275	135.319	135.888
137.343	138.063	144.203	154.302	162.498		
15.234	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	345.600	345.728	346.074	346.456	346.532	347.503
349.929	351.100	362.954	379.452	395.950		
2.099 25 14						
0.000	2.595	14.791	21.823	28.644	34.940	41.672
48.482	55.277	61.610	67.939	74.145	80.204	86.176
92.251	98.627	105.366	112.670	120.442	127.756	128.310
136.389	142.000	150.203	162.302			
14.579	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	345.600	360.954	385.452			
2.326 26 15						
0.000	3.958	17.783	26.305	34.214	41.505	48.886
56.235	63.467	70.213	76.798	83.128	89.221	95.261
101.380	107.752	114.428	121.482	129.067	136.244	136.793
143.577	150.303	155.359	158.589	162.668		
13.984	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	345.600	355.456	362.929	375.100		
2.553 23 16						
0.000	5.560	20.911	31.146	40.240	48.572	56.490
64.207	71.685	78.718	85.467	91.922	98.113	104.265
110.417	116.769	123.391	130.280	137.575	144.539	145.080
150.700	163.000					
13.498	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	362.532					
2.837 22 17						
0.000	7.890	25.123	37.445	48.093	57.579	66.173
74.284	81.976	89.129	95.920	102.517	108.882	115.189
121.330	127.614	134.139	140.955	147.897	154.548	155.068
164.776						
13.029	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
335.150						

3.121 21 18						
0.000	10.344	29.670	43.955	56.093	66.645	75.884
84.370	92.272	99.523	106.332	112.982	119.389	125.748
131.847	137.990	144.274	150.847	157.524	163.743	166.222
12.566	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	320.461
3.404 21 19						
0.000	12.667	34.421	50.832	64.367	75.828	85.666
94.482	102.551	109.864	116.709	123.382	129.785	136.076
142.066	148.008	154.002	160.234	166.483	172.064	172.482
12.100	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
3.972 21 20						
0.000	16.711	44.337	65.251	81.340	94.369	105.339
114.745	123.012	130.443	137.387	144.025	150.276	155.924
161.384	166.726	172.033	177.160	181.927	186.061	186.362
11.162	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
4.539 21 21						
0.000	21.389	55.590	80.463	98.710	113.266	125.203
135.171	143.589	151.061	157.779	163.850	169.205	174.058
178.763	183.193	187.291	190.851	194.107	196.968	197.182
10.160	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
5.106 21 22						
0.000	26.795	67.552	95.727	116.335	132.421	145.283
155.625	164.041	171.222	177.199	182.171	186.517	190.663
194.407	197.632	200.284	202.489	204.517	206.326	206.464
9.170	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
5.220 21 23						
0.000	28.035	70.009	98.774	119.879	136.318	149.371
159.691	167.988	174.929	180.672	185.441	189.695	193.651
197.160	200.127	202.534	204.546	206.380	208.024	208.148
8.981	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
5.333 21 24						
0.000	29.305	72.490	101.821	123.423	140.215	153.457
163.754	171.914	178.588	184.086	188.654	192.823	196.582
199.849	202.555	204.729	206.560	208.213	209.700	209.812
8.792	16.498	32.996	49.494	65.992	82.490	98.988

```
115.486  131.983  148.481  164.979  181.477  197.975  214.473
230.971  247.469  263.967  280.465  296.963  312.300  313.461
  5.447 21 25
  0.000   30.583   74.993  104.870  126.966  144.097  157.521
167.816  175.839  182.256  187.514  191.878  195.949  199.505
202.529  204.973  206.914  208.566  210.039  211.373  211.473
  8.600   16.498   32.996   49.494   65.992   82.490   98.988
115.486  131.983  148.481  164.979  181.477  197.975  214.473
230.971  247.469  263.967  280.465  296.963  312.300  351.100
  5.674 21 26
  0.000   33.212   80.050  111.079  134.054  151.696  165.316
175.557  183.319  189.312  194.150  198.131  201.951  205.109
207.677  209.644  211.156  212.468  213.614  214.667  214.744
  8.215   16.498   32.996   49.494   65.992   82.490   98.988
115.486  131.983  148.481  164.979  181.477  197.975  214.473
230.971  247.469  263.967  280.465  296.963  312.300  351.100
  5.901 21 27
  0.000   35.989   85.155  117.471  141.147  159.049  172.588
182.624  190.121  195.789  200.280  203.932  207.454  210.229
212.400  213.969  215.134  216.159  217.035  217.854  217.915
  7.830   16.498   32.996   49.494   65.992   82.490   98.988
115.486  131.983  148.481  164.979  181.477  197.975  214.473
230.971  247.469  263.967  280.465  296.963  312.300  351.100
  6.128 22 28
  0.000   38.898   90.295  123.987  148.242  166.201  179.440
189.157  196.383  201.794  205.994  209.357  212.546  214.953
216.775  218.015  218.899  219.682  220.334  220.959  220.959
220.959
  7.445   16.498   32.996   49.494   65.992   82.490   98.988
115.486  131.983  148.481  164.979  181.477  197.975  214.473
230.971  247.469  263.967  280.465  296.963  312.300  340.000
351.100
  6.411 22 29
  0.000   42.698   96.748  132.220  157.114  174.922  187.567
196.780  203.655  208.795  212.678  215.719  218.465  220.432
221.872  222.773  223.381  223.910  224.336  224.759  224.791
224.791
  6.963   16.498   32.996   49.494   65.992   82.490   98.988
115.486  131.983  148.481  164.979  181.477  197.975  214.473
230.971  247.469  263.967  280.465  296.963  312.300  313.461
351.100
  6.695 28 30
  0.000   46.650  103.209  140.442  165.983  183.477  195.385
204.041  210.544  215.421  219.007  221.749  224.041  225.591
226.695  227.315  227.703  228.022  228.258  228.509  228.529
228.853  228.154  228.156  228.162  228.169  228.170  228.170
  6.482   16.498   32.996   49.494   65.992   82.490   98.988
```

115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	345.600	345.728	346.074	346.456	346.532	351.100
6.979 30 31						
0.000	50.723	109.653	148.542	174.849	191.947	203.085
211.193	217.301	221.868	225.142	227.586	229.436	230.595
231.388	231.760	231.962	232.097	232.165	232.254	232.263
232.424	232.656	232.658	232.665	232.673	232.675	232.707
232.757	232.752					
6.000	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	345.600	345.728	346.074	346.456	346.532	347.503
349.929	351.100					
7.660 28 32						
0.000	61.287	125.358	166.233	192.115	208.109	218.126
225.316	230.494	234.096	236.573	238.335	239.474	240.075
240.418	240.473	240.447	240.366	240.229	240.110	240.104
240.110	240.110	240.110	240.110	240.110	240.110	240.110
4.845	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	345.600	345.728	346.074	346.456	346.532	351.100
8.340 28 33						
0.000	72.614	141.173	181.205	204.044	218.576	227.929
234.323	238.533	241.153	242.936	244.170	244.987	245.455
245.714	245.786	245.794	245.764	245.713	245.665	245.662
246.100	246.100	246.100	246.100	246.100	246.100	246.100
3.689	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	345.600	345.728	346.074	346.456	346.532	351.103
9.021 27 34						
0.000	84.212	155.597	193.625	214.077	226.916	235.199
240.452	243.577	245.443	246.719	247.608	248.193	248.589
248.857	249.012	249.083	249.132	249.246	249.354	249.360
249.360	249.360	249.360	249.360	249.360	249.360	
2.534	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	345.600	345.728	346.074	348.000	351.100	
9.362 23 35						
0.000	90.178	161.532	198.629	218.491	230.639	238.419
243.141	245.783	247.332	248.386	249.120	249.592	249.936
250.186	250.348	250.415	250.465	250.613	250.748	250.756
250.484	250.218					
1.955	16.498	32.996	49.494	65.992	82.490	98.988

115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	351.100					
9.702 23 36						
0.000	96.122	166.720	202.711	222.163	233.757	241.105
245.372	247.604	248.878	249.729	250.313	250.671	250.946
251.158	251.302	251.356	251.405	251.563	251.705	251.713
251.682	251.652					
1.377	16.498	32.996	49.494	65.992	82.490	98.988
115.486	131.983	148.481	164.979	181.477	197.975	214.473
230.971	247.469	263.967	280.465	296.963	312.300	313.461
329.959	351.100					
10.043 22 37						
0.000	101.922	171.256	205.784	224.828	236.026	243.037
246.963	248.878	249.922	250.591	251.026	251.267	251.454
251.602	251.701	251.751	251.815	251.969	252.115	252.220
252.301						
0.800	16.498	32.996	49.493	65.991	82.489	98.987
115.485	131.982	148.480	164.978	181.476	197.973	214.471
230.969	247.467	263.965	280.462	296.960	313.458	329.956
351.100						
10.950 23 38						
0.000	50.881	107.283	172.107	206.005	224.953	236.064
243.180	247.171	249.020	250.000	250.573	250.967	251.132
251.204	251.256	251.269	251.289	251.350	251.446	251.532
251.730	251.856					
0.000	8.000	16.498	32.996	49.493	65.991	82.489
98.987	115.485	131.982	148.480	164.978	181.476	197.973
214.471	230.969	247.467	263.965	280.462	296.960	313.458
329.956	351.000					
11.858 23 39						
0.000	50.331	100.182	158.582	195.109	215.448	227.956
236.488	241.805	244.711	246.448	247.493	248.316	248.725
248.905	248.993	249.013	248.998	248.997	248.995	248.977
249.027	249.014					
0.000	8.000	16.498	32.996	49.493	65.991	82.489
98.987	115.485	131.982	148.480	164.978	181.476	197.973
214.471	230.969	247.467	263.965	280.462	296.960	313.458
329.956	351.100					
12.766 23 40						
0.000	0.965	91.689	141.354	178.875	201.446	216.406
226.788	233.851	238.444	241.404	243.202	244.590	245.347
245.804	245.987	246.097	246.067	245.994	245.903	245.793
245.664	245.515					
0.000	8.000	16.498	32.996	49.493	65.991	82.489
98.987	115.485	131.982	148.480	164.978	181.476	197.973
214.471	230.969	247.467	263.965	280.462	296.960	313.458

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329.956   351.100
 13.277 23 41
  0.000    25.400    86.398   129.972   166.049   190.131   206.990
218.420   226.800   232.705   236.712   239.235   241.082   242.158
242.946   243.284   243.558   243.597   243.493   243.386   243.290
243.144   243.009
  0.000     8.000    16.498    32.996    49.493    65.991    82.489
 98.987   115.485   131.982   148.480   164.978   181.476   197.973
214.471   230.969   247.467   263.965   280.462   296.960   313.458
329.956   351.100
 13.787 23 42
  0.000    25.400    74.642   113.910   148.196   173.996   193.165
206.244   216.433   223.989   229.409   233.041   235.602   237.194
238.476   239.102   239.651   239.838   239.677   239.559   239.492
239.385   239.319
  0.000     8.000    16.498    32.996    49.493    65.991    82.489
 98.987   115.485   131.982   148.480   164.978   181.476   197.973
214.471   230.969   247.467   263.965   280.462   296.960   313.458
329.956   351.100
 14.298 22 43
  0.000    52.397    94.147   127.789   155.378   176.912   192.997
205.062   214.261   221.108   225.974   229.386   231.579   233.351
234.302   235.122   235.452   235.161   234.977   234.817   234.730
234.715
  2.902    16.498    32.996    49.493    65.991    82.489    98.987
115.485   131.982   148.480   164.978   181.476   197.973   214.471
230.969   247.467   263.965   280.462   296.960   313.458   329.956
351.100
 14.695 22 44
  0.000    52.389    77.541   111.835   140.773   164.021   182.630
196.276   206.710   214.580   220.438   224.573   227.239   229.330
230.522   231.502   231.901   231.463   231.178   230.951   230.841
230.820
  6.523    20.498    32.996    49.493    65.991    82.489    98.987
115.485   131.982   148.480   164.978   181.476   197.973   214.471
230.969   247.467   263.965   280.462   296.960   313.458   329.956
351.100
 15.092 22 45
  0.000    52.389    59.685    95.466   125.730   150.625   171.113
186.635   198.396   207.369   214.283   219.233   222.440   224.853
226.322   227.462   227.955   227.395   227.022   226.794   226.636
226.571
 12.368    25.498    30.000    49.493    65.991    82.489    98.987
115.485   131.982   148.480   164.978   181.476   197.973   214.471
230.969   247.467   263.965   280.462   296.960   313.458   329.956
351.100
 15.489 21 46
```

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  0.000    38.785    77.342   108.949   135.465   157.818   175.322
188.482   198.754   206.725   212.609   216.522   219.316   221.156
222.521   223.224   222.625   222.229   221.913   221.677   221.529
 21.118    32.996    49.493    65.991    82.489    98.987   115.485
131.982   148.480   164.978   181.476   197.973   214.471   230.969
247.467   263.965   280.462   296.960   313.458   329.956   351.100
 16.397 17 47
  0.000    77.342   108.949   135.465   117.850   143.410   161.289
175.641   186.428   194.901   201.049   204.995   207.833   209.805
211.130   210.598   210.275
 45.157    73.000    95.000   110.000    98.987   115.485   131.982
148.480   164.978   181.476   197.973   214.471   230.969   247.467
263.965   280.462   296.960
 17.305 15 48
  0.000    50.000    68.066   105.924   130.685   150.309   164.600
175.905   184.389   189.804   193.775   196.465   198.450   198.142
197.964
 69.515    85.000    95.000   115.485   131.982   148.480   164.978
181.476   197.973   214.471   230.969   247.467   263.965   280.462
296.960
 18.213 14 49
  0.000    15.836    65.140    97.719   123.207   141.377   155.232
165.222   172.407   177.837   181.630   184.563   184.828   184.950
 94.163    98.987   115.485   131.982   148.480   164.978   181.476
197.973   214.471   230.969   247.467   263.965   280.462   296.960
 18.383 13 50
  0.000    15.823    56.753    91.051   117.761   136.806   151.114
161.267   168.841   174.588   178.631   181.764   182.189
 98.671   102.987   115.485   131.982   148.480   164.978   181.476
197.973   214.471   230.969   247.467   263.965   296.960
 18.553 12 51
  0.000    47.538    83.897   111.983   132.064   146.690   157.204
165.241   171.305   175.559   178.820   179.398
103.315   115.485   131.982   148.480   164.978   181.476   197.973
214.471   230.969   247.467   263.965   296.960
 18.723 13 52
  0.000    30.854    72.403   103.229   125.551   141.675   153.000
161.596   167.972   172.374   175.642   176.325   176.618
108.726   115.485   131.982   148.480   164.978   181.476   197.973
214.471   230.969   247.467   263.965   280.462   296.960
 19.149 12 53
  0.000    72.403   100.000   125.551   127.981   142.287   152.422
159.573   164.234   167.296   168.111   168.363
128.062   143.000   155.480   178.978   180.476   197.973   214.471
230.969   247.467   263.965   280.462   296.960
 19.574 10 54
  0.000    99.673   113.965   131.556   143.245   151.171   156.075
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  158.872   159.755   159.908
  153.393   170.000   181.476   197.973   214.471   230.969   247.467
  263.965   280.462   296.960
   20.000  9 55
    0.000    99.673   120.769   134.050   142.750   147.871   150.346
  151.269   151.300
  180.000   181.476   197.973   214.471   230.969   247.467   263.965
  280.462   296.960
LOCATION REFERENCE LINES   Reference line flag
   7      Number of reference lines
   4 LD   Number of data points and line identification characters
   0.0     180.0      0.0     X,Y,Z coordinates of data points
 119.875   174.1     480.0
 191.25    170.6     768.0          LD=lower deck
 251.5     162.8    1416.0
  12 UD
  17.5     331.19    -72.0
  27.75    328.75    -48.0
  36.25    326.37    -24.0
  44.0     324.0       0.0
  58.5     319.25     48.0          UD=upper deck
  71.56    317.56     96.0
  84.25    309.87    144.0
 107.94    301.31    240.0
 135.0     292.0     360.0
 159.56    283.75    480.0
 208.25    267.56    768.0
 251.62    252.19   1416.0
  12 FD
   8.5     431.31   -144.0
  43.5     428.75   -120.0
  60.25    426.12    -96.0
  71.25    423.5     -72.0
  80.5     420.94    -48.0          FD=forward deck
  89.0     418.37    -24.0
  97.12    415.75      0.0
 112.06    410.75     48.0
 125.75    405.81     96.0
 137.19    401.0     144.0
 158.37    392.0     240.0
 166.5     390.0     288.0
   1 IB
 150.0       0.0       0.0          IB=ice belt
   1 IB
 216.0       0.0       0.0
  16 BW
  61.25    479.43   -144.0
```

77.625	476.312	-120.0	
88.687	473.250	-96.0	
97.000	470.250	-72.0	
103.75	467.250	-48.0	
109.500	464.313	-24.0	
114.75	461.313	0.0	
119.625	458.438	24.0	BW=bulwark
124.375	455.500	48.0	
129.000	452.562	72.0	
133.687	449.75	96.0	
138.250	446.938	120.0	
142.750	444.187	144.0	
147.250	441.375	168.0	
151.625	438.687	192.0	
156.000	436.000	216.0	
17 KN			
45.750	431.75	-120.0	
62.250	429.125	-96.0	
73.250	426.500	-72.0	
82.375	423.938	-48.0	
91.000	412.375	-24.0	KN=knuckle
99.125	418.75	0.0	
106.813	416.250	24.0	
114.063	413.750	48.0	
121.000	411.250	72.0	
127.750	408.813	96.0	
134.125	406.375	120.0	
140.250	404.000	144.0	
145.750	401.687	168.0	
150.875	399.375	192.0	
155.687	397.125	216.0	
160.187	395.000	240.0	
164.312	393.000	264.0	

Appendix B

Beam Data File BEAMS.DAT

```
CFAV QUEST
  19  NUMBER OF BEAM TYPES
   1   6X1PL
   0 BEAM PROPERTIES OPTION
     6.00      2.39     18.00      0.50      0.00   0.00   0.00   1.00   1.00
    3.000     0.000  beam eccentricities
     0.50      0.50     -0.50     -0.50      3.00     -3.00      3.00     -3.00
   2   6X3.5A
   0 BEAM PROPERTIES OPTION
     4.16      0.33      3.97     15.40      0.00   1.84   2.45   1.00   1.00
    3.932     0.000
     0.82      0.82     -5.18     -5.18     -3.93     -0.43     -3.93     -3.47
   3   4X.5PL
   0 BEAM PROPERTIES OPTION
     2.00      0.15      2.67      0.04      0.00   0.00   0.00   1.00   1.00
    0.250     0.000
     0.25      0.25     -0.25     -0.25      2.00     -2.00      2.00     -2.00
   4   6X3.5X.3
   0 BEAM PROPERTIES OPTION
     3.11      0.12      3.07     11.80      0.00   1.85   2.56   1.00   1.00
    3.976     0.000
     0.77      0.77     -5.23     -5.23     -3.98     -0.48     -3.98     -3.64
   5   4X3A
   0 BEAM PROPERTIES OPTION
     1.69      0.04      1.36      2.77      0.00   1.11   2.14   1.00   1.00
    2.764     0.000
     0.74      0.74     -3.26     -3.26     -2.76      0.24     -2.76     -2.51
   6   12X6T
   0 BEAM PROPERTIES OPTION
     7.31      0.45      9.05    111.00      0.00   3.54   0.00   1.00   1.00
    8.212     0.000
```

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   3.79      3.79     -8.21     -8.21      3.00     -3.00      0.19     -0.19
 7  4X3X.27A
 0 BEAM PROPERTIES OPTION
   1.82      0.05      1.45      2.97      0.00   1.11   2.12   1.00   1.00
  2.757     0.000
   0.74      0.74     -3.26     -3.26     -2.76      0.24     -2.76     -2.49
 8  2X2A
 0 BEAM PROPERTIES OPTION
   0.94      0.02      0.35      0.35      0.00   0.47   1.28   1.00   1.00
  1.408     0.000
   0.59      0.59     -1.41     -1.41     -1.41      0.59     -1.41     -1.16
 9  .5X3A
 0 BEAM PROPERTIES OPTION
   2.09      0.05      1.54      5.48      0.00   1.53   2.20   1.00   1.00
  3.335     0.000
   0.67      0.67     -4.34     -4.34     -3.34     -0.34     -3.34     -3.07
10  12X6T
 0 BEAM PROPERTIES OPTION
   9.89      1.05     11.40    150.00      0.00   3.73   0.00   1.00   1.00
  7.962     0.000
   4.04      4.04     -7.96     -7.96      3.00     -3.00      0.27     -0.27
11  2.5A
 0 BEAM PROPERTIES OPTION
   0.96      0.01      0.58      0.58      0.00   0.60   1.70   1.00   1.00
  1.801     0.000
   0.70      0.70     -1.80     -1.80     -1.80      0.70     -1.80     -1.60
12  4X3X.31A
 0 BEAM PROPERTIES OPTION
   2.07      0.07      1.63      3.36      0.00   1.10   2.09   1.00   1.00
  2.742     0.000
   0.76      0.76     -3.24     -3.24     -2.74      0.26     -2.74     -2.43
13  3.5X5/16
 0 BEAM PROPERTIES OPTION
   1.09      0.04      1.12      0.01      0.00   0.00   0.00   1.00   1.00
  0.156     0.000
   0.16      0.16     -0.16     -0.16      1.75     -1.75      1.75     -1.75
14  LOW BUL
 0 BEAM PROPERTIES OPTION
   2.87      0.10      0.57     16.60      0.00   2.93   1.50   1.00   1.00
  4.410     0.000
   0.34      0.34     -7.16     -7.16     -4.41     -2.41     -4.41     -4.10
15  UPP BUL
 0 BEAM PROPERTIES OPTION
   1.93      0.07      0.52      4.06      0.00   1.52   1.41   1.00   1.00
  2.821     0.000
   0.43      0.43     -4.07     -4.07     -2.82     -0.82     -2.82     -2.51
16  12X6 T
```

```
 0 BEAM PROPERTIES OPTION
    5.85     0.21     5.66    91.10     0.00   4.08   0.00   1.00   1.00
   7.767    0.000
    4.23     4.23    -7.77    -7.77     3.00    -3.00     0.17    -0.17
17  3P X SCH 80
 0 BEAM PROPERTIES OPTION
    3.02     4.44     3.89     3.89     0.00   0.00   0.00   1.00   1.00
   0.000    0.000
    1.00     1.00     1.00     1.00     1.00     1.00     1.00     1.00
18  T 6 X 24
 1 BEAM PROPERTIES OPTION
    0.00     0.00     0.00     0.00     0.00   0.00   0.00   0.00   0.00
 10    1    0    6.000   24.000    0.375    0.375
  12.000    0.000
    1.00     1.00     1.00     1.00     1.00     1.00     1.00     1.00
19 WT 9 X 59.5
 1 BEAM PROPERTIES OPTION
    0.00     0.00     0.00     0.00     0.00   0.00   0.00   0.00   0.00
 10    0    0   11.265    9.485    1.060    0.655
   7.600    0.000
    2.03     2.03    -7.45    -7.45     5.60    -5.60     0.33    -0.33
```

Appendix C

Basic Data File FRAME.DXX

The following is an example of a basic data file FRAME.DXX for two panels. The file contains coordinates for the 12 panel nodes and beam size and gridding information.

```
CNAV QUEST
BOW3
 2820.000     LENGTH BETWEEN PERPENDICULARS
  2   0  MODELLING OPTION MODL AND IFORM
  1   0  GRID OPTION:MOPT  SMEARED STIFFENER OPTION:MODEL
 19  NUMBER OF BEAM TYPES
 12   2 NUMBER OF PANEL COORDINATES AND OPTION IOPT
      0.000      143.961  FORWARD AND AFT SECTION LOCATION
  2  NUMBER OF PANELS
  7   1 NUMBER OF VERTICAL  BEAMS   NUMBER OF PLATES BETWEEN BEAMS
  0   ISP
  1   2 MODELLING OPTION
  1   NUMBER OF BEAM TYPES IN PANEL   1
  2   6X3.5A
  4   NUMBER OF VERTICAL      BEAMS
  0   IXSP
  1   1 DUPLICATE BEAM FLAGS
  0.313   PLATE THICKNESS
0.300E+08   0.300 0.734E-03
COORD SIDE
     113.59      460.45        0.00
     108.95      445.86        0.00
     102.02      429.05        0.00
      96.86      416.02        0.00
     107.70      412.18       47.94
     122.16      406.82       96.02
     133.87      403.27      143.96
```

```
    138.16      416.02      143.96
    141.00      429.82      143.96
    142.81      445.93      143.96
    133.25      448.99       96.02
    123.96      454.36       47.94
  1   2 MODELLING OPTION
  1   NUMBER OF BEAM TYPES IN PANEL   2
  2   6X3.5A
  8   NUMBER OF VERTICAL      BEAMS
  0   IXSP
  0   0 DUPLICATE BEAM FLAGS
  0.290   PLATE THICKNESS
0.300E+08   0.300 0.734E-03
COORD DECK
      0.00      416.02        0.00
     37.23      416.02        0.00
     67.43      416.02        0.00
     96.86      416.02        0.00
    107.44      412.18       47.94
    122.16      406.82       96.02
    133.86      403.27      143.96
     95.31      402.98      143.96
     46.26      402.98      143.96
      0.00      402.98      143.96
      0.00      406.05       96.02
      0.00      411.42       47.94
```

Appendix D

Basic Panel Data File PANEL.DAT

The following is an example of a PANEL.DAT file which contains the the name of the section in which the panels are located and the number of panels and the number of nodes in the ungridded panel. Also listed are the material properties, beam properties, beam eccentricities, stress points, the number of frames and beams, plate thickness and grid bias. This data is followed by the coordinates of the 12 panel points.

```
BOW7
 17  12   NUMBER OF PANELS   NUMBER OF NODES IN PANELS
 0.300E+08   0.300 0.734E-03
  1
 0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
     3.932      0.000 BEAM ECCENTRICITIES
   0.82    0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
 11  4    0.313   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
 COORD
      172.08       313.23       479.96
      168.63       303.36       479.96
      163.99       291.10       479.96
      161.15       283.43       479.96
      176.38       278.06       560.05
      189.80       274.23       640.00
      201.23       271.13       719.95
      202.45       280.36       719.95
      204.52       296.46       719.95
      206.07       313.33       719.95
      196.77       313.33       640.00
```

```
   186.19      313.33      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
    3.932      0.000 BEAM ECCENTRICITIES
   0.82     0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  8    0.290   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
      0.00      283.43      479.96
     47.30      283.43      479.96
    103.58      283.43      479.96
    161.15      283.43      479.96
    176.38      278.06      560.05
    189.54      274.23      640.00
    201.23      271.13      719.95
    137.65      270.40      719.95
     67.18      270.40      719.95
      0.06      270.40      719.95
      0.06      273.46      640.00
      0.06      277.30      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
    3.932      0.000 BEAM ECCENTRICITIES
   0.82     0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  4    0.600   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
    161.34      283.37      479.96
    153.92      264.27      479.96
    144.62      237.44      479.96
    136.36      215.97      479.96
    156.50      216.74      560.05
    174.57      216.74      640.00
    190.83      216.74      719.95
    194.97      234.37      719.95
    198.58      252.77      719.95
    201.23      271.13      719.95
    189.56      274.48      640.00
    176.26      278.05      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
    3.932      0.000 BEAM ECCENTRICITIES
   0.82     0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  4    0.600   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
    136.25      215.53      479.96
```

```
        131.20       202.18       479.96
        126.55       189.91       479.96
        121.44       176.62       479.96
        141.01       174.58       560.05
        160.63       173.05       640.00
        178.70       171.51       719.95
        183.86       187.61       719.95
        187.74       202.94       719.95
        190.95       216.32       719.95
        175.32       216.32       640.00
        157.27       216.25       560.05
 0.300E+08   0.300 0.734E-03
   1
 0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00      2.      2.    1.    1.    0
     3.932      0.000 BEAM ECCENTRICITIES
    0.82      0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
 11  8    0.290   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
 COORD
          0.00       175.35       479.96
         39.56       175.35       479.96
         82.93       175.35       479.96
        121.28       176.04       479.96
        141.01       174.58       560.05
        160.63       173.05       640.00
        178.44       171.51       719.95
        126.30       171.51       719.95
         65.63       171.51       719.95
          0.00       171.51       719.95
          0.00       172.28       640.00
          0.00       173.05       560.05
 0.300E+08   0.300 0.734E-03
   1
 0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00      2.      2.    1.    1.    0
     3.932      0.000 BEAM ECCENTRICITIES
    0.82      0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
 11  4    0.600   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
 COORD
        121.44       176.62       479.96
        117.26       166.15       479.96
        114.16       157.71       479.96
        110.29       150.82       479.96
        131.46       150.82       560.05
        151.85       150.82       640.00
        171.73       150.82       719.95
        174.31       156.95       719.95
        176.89       163.85       719.95
        179.24       171.14       719.95
```

```
    160.58      172.92      640.00
    141.50      174.61      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
    3.932     0.000 BEAM ECCENTRICITIES
   0.82     0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  4    0.500   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
    110.45      150.72      479.96
     89.12      105.59      479.96
     60.47       61.13      479.96
     27.16       27.40      479.96
     34.99       27.39      560.05
     45.24       27.40      640.00
     53.95       27.39      719.95
    101.51       53.46      719.95
    145.92       99.46      719.95
    171.73      150.82      719.95
    151.08      150.82      640.00
    130.68      150.82      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
    3.932     0.000 BEAM ECCENTRICITIES
   0.82     0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  4    0.500   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
     27.16       27.40      479.96
     18.48       20.88      479.96
     12.25       16.22      479.96
      0.00       12.07      479.96
      0.00       11.13      560.05
      0.00       10.15      640.00
      0.00        9.16      719.95
     18.48       14.09      719.95
     33.11       19.06      719.95
     53.95       27.39      719.95
     44.23       27.39      640.00
     34.99       27.39      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
    3.932     0.000 BEAM ECCENTRICITIES
   0.82     0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  4    0.500   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
```

```
      0.00        12.07       479.96
    -12.25        16.22       479.96
    -18.48        20.88       479.96
    -27.16        27.40       479.96
    -34.99        27.39       560.05
    -44.23        27.39       640.00
    -53.95        27.39       719.95
    -33.11        19.06       719.95
    -18.48        14.09       719.95
      0.00         9.16       719.95
      0.00        10.15       640.00
      0.00        11.13       560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00      2.      2.    1.    1.     0
    3.932      0.000 BEAM ECCENTRICITIES
   0.82     0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  4    0.500  0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
    -27.16        27.40       479.96
    -60.47        61.13       479.96
    -89.12       105.59       479.96
   -110.45       150.72       479.96
   -130.68       150.82       560.05
   -151.08       150.82       640.00
   -171.73       150.82       719.95
   -145.92        99.46       719.95
   -101.51        53.46       719.95
    -53.95        27.39       719.95
    -45.24        27.40       640.00
    -34.99        27.39       560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00      2.      2.    1.    1.     0
    3.932      0.000 BEAM ECCENTRICITIES
   0.82     0.82    -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  4    0.600  0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
   -110.29       150.82       479.96
   -114.16       157.71       479.96
   -117.26       166.15       479.96
   -121.44       176.62       479.96
   -141.50       174.61       560.05
   -160.58       172.92       640.00
   -179.24       171.14       719.95
   -176.89       163.85       719.95
   -174.31       156.95       719.95
```

```
    -171.73      150.82      719.95
    -151.85      150.82      640.00
    -131.46      150.82      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
    3.932      0.000 BEAM ECCENTRICITIES
   0.82     0.82   -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  8    0.290   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
    -121.28      176.04      479.96
     -82.93      175.35      479.96
     -39.56      175.35      479.96
       0.00      175.35      479.96
       0.00      173.05      560.05
       0.00      172.28      640.00
       0.00      171.51      719.95
     -65.63      171.51      719.95
    -126.30      171.51      719.95
    -178.44      171.51      719.95
    -160.63      173.05      640.00
    -141.01      174.58      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
    3.932      0.000 BEAM ECCENTRICITIES
   0.82     0.82   -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  4    0.600   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
    -121.44      176.62      479.96
    -126.55      189.91      479.96
    -131.20      202.18      479.96
    -136.25      215.53      479.96
    -157.27      216.25      560.05
    -175.32      216.32      640.00
    -190.95      216.32      719.95
    -187.74      202.94      719.95
    -183.86      187.61      719.95
    -178.70      171.51      719.95
    -160.63      173.05      640.00
    -141.01      174.58      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.    1.    1.     0
    3.932      0.000 BEAM ECCENTRICITIES
   0.82     0.82   -5.18    -5.18    -3.93    -0.43    -3.93    -3.47     0.00
11  4    0.600   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
```

```
COORD
    -136.36      215.97      479.96
    -144.62      237.44      479.96
    -153.92      264.27      479.96
    -161.34      283.37      479.96
    -176.26      278.05      560.05
    -189.56      274.48      640.00
    -201.23      271.13      719.95
    -198.58      252.77      719.95
    -194.97      234.37      719.95
    -190.83      216.74      719.95
    -174.57      216.74      640.00
    -156.50      216.74      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.   1.   1.    0
    3.932     0.000 BEAM ECCENTRICITIES
   0.82     0.82   -5.18   -5.18   -3.93   -0.43   -3.93   -3.47    0.00
11  8   0.290  0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
    -161.15      283.43      479.96
    -103.58      283.43      479.96
     -47.30      283.43      479.96
       0.00      283.43      479.96
      -0.06      277.30      560.05
      -0.06      273.46      640.00
      -0.06      270.40      719.95
     -67.18      270.40      719.95
    -137.65      270.40      719.95
    -201.23      271.13      719.95
    -189.54      274.23      640.00
    -176.38      278.06      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.   1.   1.    0
    3.932     0.000 BEAM ECCENTRICITIES
   0.82     0.82   -5.18   -5.18   -3.93   -0.43   -3.93   -3.47    0.00
11  4   0.313  0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
    -161.15      283.43      479.96
    -163.99      291.10      479.96
    -168.63      303.36      479.96
    -172.08      313.23      479.96
    -186.19      313.33      560.05
    -196.77      313.33      640.00
    -206.07      313.33      719.95
    -204.52      296.46      719.95
```

```
    -202.45       280.36      719.95
    -201.23       271.13      719.95
    -189.80       274.23      640.00
    -176.38       278.06      560.05
0.300E+08   0.300 0.734E-03
  1
0.416E+01 0.330E+00 0.397E+01 0.154E+02 0.000E+00     2.     2.   1.   1.    0
    3.932     0.000 BEAM ECCENTRICITIES
   0.82    0.82   -5.18   -5.18   -3.93   -0.43   -3.93   -3.47    0.00
11 16   0.290   0 NUMBER OF FRAMES & BEAMS,PLATE THICK,BIAS
COORD
       0.61         9.91      479.96
       0.61        61.46      479.96
       0.61       116.09      479.96
       0.61       175.34      479.96
       0.61       173.80      560.05
       0.61       172.26      640.00
       0.61       170.72      719.95
       0.61       116.09      719.95
       0.61        61.46      719.95
       0.61         9.14      719.95
       0.61         9.14      640.00
       0.61         9.14      560.05
```

Appendix E

Panel Grid Coordinate File MODEL.DAT

This file lists the number of panels, the panel grids and the coordinates of the gridded panels.

```
 10                                  number of panels
            6           5            number of frames    number of beams
       104.05      438.35     191.00
       115.79      427.38     211.76
       127.95      414.29     232.15
       139.23      400.44     252.61
       148.29      387.14     273.55
       153.79      375.78     295.42
       104.72      426.40     189.13
       115.77      417.16     210.27
       127.26      406.23     231.12
       138.12      394.73     252.00
       147.21      383.80     273.29
       153.43      374.57     295.32
       104.52      414.66     187.45
       115.03      407.08     208.96
       126.01      398.23     230.21
       136.59      389.02     251.48
       145.88      380.38     273.06
       152.98      373.21     295.22
       103.49      404.03     186.12
       113.65      397.98     207.91
       124.32      391.08     229.51
       134.83      384.04     251.12
       144.50      377.54     272.93
       152.68      372.31     295.15
```

101.64	395.43	185.24
111.71	390.73	207.25
122.29	385.60	229.13
132.96	380.52	250.99
143.26	375.99	272.96
152.76	372.51	295.16
6	9	
-28.30	372.18	208.46
-23.07	365.60	231.19
-17.90	359.44	254.02
-12.81	353.86	276.95
-7.83	349.01	299.96
-3.00	345.07	323.05
-12.68	374.95	205.67
-7.48	368.50	228.42
-2.27	362.36	251.24
2.87	356.73	274.16
7.87	351.82	297.15
12.64	347.83	320.25
4.48	377.98	202.59
9.50	371.63	225.40
14.63	365.48	248.24
19.69	359.80	271.16
24.58	354.80	294.17
29.16	350.74	317.29
22.49	381.12	199.36
27.38	374.89	222.21
32.42	368.76	245.07
37.44	363.02	268.00
42.25	357.94	291.01
46.65	353.82	314.16
40.69	384.32	196.10
45.62	378.23	218.96
50.76	372.13	241.81
55.91	366.37	264.70
60.81	361.25	287.69
65.24	357.10	310.83
58.38	387.45	192.94
63.69	381.55	215.75
69.28	375.56	238.52
74.90	369.82	261.32
80.25	364.72	284.21
85.04	360.59	307.29
74.87	390.42	189.99
81.07	384.80	212.66
87.63	378.97	235.26
94.21	373.36	257.88

100.50	368.33	280.60
106.15	364.32	303.51
89.51	393.12	187.39
97.25	387.89	209.80
105.42	382.34	232.11
113.64	376.93	254.42
121.52	372.09	276.84
128.68	368.28	299.47
101.61	395.47	185.26
111.71	390.74	207.26
122.30	385.59	229.12
132.96	380.52	250.99
143.26	375.99	272.96
152.76	372.51	295.16
6	5	
101.57	395.49	185.27
112.53	390.53	207.05
123.14	385.39	228.92
133.40	380.43	250.89
143.26	376.03	272.96
152.75	372.52	295.16
92.83	371.55	183.57
103.33	366.10	205.38
113.55	360.39	227.24
123.49	354.76	249.18
133.09	349.56	271.19
142.38	345.12	293.29
83.11	346.18	181.86
93.94	341.63	203.74
104.54	336.74	225.64
114.89	331.82	247.59
125.00	327.23	269.59
134.87	323.25	291.64
73.71	320.35	180.02
84.92	316.82	201.97
95.95	312.85	223.92
106.80	308.78	245.89
117.47	304.89	267.88
127.97	301.48	289.88
65.91	295.06	177.93
76.86	291.36	199.91
87.66	287.16	221.87
98.36	282.75	243.83
108.94	278.40	265.76
119.45	274.41	287.68
6	9	
65.66	295.08	177.99

77.24	291.05	199.79
87.95	286.89	221.78
98.22	282.68	243.85
108.47	278.48	265.87
119.10	274.35	287.75
58.16	293.72	179.33
67.92	289.45	201.46
76.93	285.04	223.76
85.56	280.54	246.13
94.17	276.02	268.44
103.12	271.53	290.61
48.78	292.05	181.00
57.28	287.62	203.37
65.13	283.05	225.89
72.68	278.37	248.45
80.21	273.63	270.95
88.03	268.87	293.31
38.08	290.15	182.92
45.74	285.66	205.45
52.86	280.98	228.10
59.73	276.18	250.78
66.59	271.29	273.40
73.70	266.34	295.88
26.65	288.13	184.96
33.74	283.61	207.61
40.41	278.89	230.34
46.89	274.02	253.09
53.37	269.03	275.78
60.05	263.94	298.32
15.04	286.09	187.04
21.71	281.56	209.77
28.09	276.83	232.56
34.32	271.91	255.36
40.56	266.84	278.08
46.96	261.63	300.66
3.85	284.11	189.05
10.11	279.60	211.86
16.20	274.84	234.71
22.19	269.88	257.55
28.20	264.73	280.30
34.34	259.40	302.92
-6.38	282.31	190.88
-0.65	277.77	213.80
5.02	272.98	236.73
10.66	267.94	259.63
16.32	262.69	282.44
22.06	257.24	305.12

-15.06	280.78	192.43
-10.11	276.17	215.50
-5.12	271.29	238.56
-0.10	266.16	261.57
4.96	260.76	284.48
10.03	255.12	307.28
6	5	
65.66	295.08	177.99
77.01	291.03	199.83
87.85	286.86	221.79
98.41	282.67	243.81
108.91	278.54	265.79
119.56	274.56	287.68
59.22	272.68	176.04
70.34	268.63	197.93
81.10	264.49	219.91
91.66	260.34	241.93
102.17	256.24	263.92
112.77	252.24	285.82
52.83	247.51	173.68
63.86	243.88	195.65
74.70	240.22	217.69
85.43	236.54	239.74
96.09	232.89	261.76
106.77	229.31	283.71
46.82	221.80	171.17
57.87	218.84	193.23
68.87	215.86	215.33
79.82	212.87	237.44
90.72	209.90	259.51
101.58	206.96	281.52
41.62	197.79	168.73
52.66	195.50	190.90
63.82	193.23	213.07
75.01	190.96	235.23
86.16	188.70	257.36
97.18	186.42	279.42
6	5	
41.34	196.85	168.65
52.55	194.71	190.80
63.76	192.49	212.97
74.95	190.21	235.14
86.08	187.93	257.26
97.11	185.67	279.33
39.45	187.38	167.66
50.50	185.10	189.82
61.60	182.76	212.00

72.70	180.39	234.17
83.78	178.03	256.29
94.82	175.68	278.34
37.93	179.43	166.82
48.88	176.83	188.95
59.91	174.21	211.10
70.99	171.57	233.23
82.09	168.94	255.31
93.21	166.33	277.31
36.43	170.82	165.87
47.28	168.09	188.00
58.22	165.34	210.15
69.25	162.60	232.28
80.35	159.88	254.35
91.51	157.18	276.32
34.63	159.36	164.57
45.25	157.00	186.80
56.01	154.66	209.05
66.89	152.34	231.27
77.88	150.05	253.42
88.99	147.79	275.47
6	9	
34.45	159.33	164.60
45.19	157.06	186.83
56.05	154.75	209.05
67.04	152.45	231.25
78.15	150.18	253.39
89.38	148.00	275.42
30.81	158.69	165.25
41.49	156.25	187.46
52.28	153.82	209.69
63.19	151.44	231.90
74.19	149.09	254.04
85.29	146.79	276.08
27.21	158.05	165.89
37.28	155.39	188.20
47.44	152.79	210.53
57.68	150.25	232.85
68.00	147.76	255.11
78.41	145.28	277.27
23.59	157.42	166.54
32.68	154.49	189.01
41.81	151.69	211.52
51.00	148.96	234.03
60.27	146.27	256.48
69.60	143.60	278.83
19.92	156.77	167.20

27.81	153.58	189.88
35.72	150.54	212.60
43.68	147.61	235.33
51.68	144.73	258.01
59.75	141.84	280.59
16.10	156.10	167.88
22.80	152.64	190.77
29.49	149.39	213.71
36.20	146.27	236.67
42.94	143.21	259.58
49.73	140.11	282.39
12.11	155.39	168.60
17.78	151.71	191.66
23.43	148.27	214.79
29.07	145.01	237.95
34.71	141.79	261.06
40.40	138.51	284.07
7.87	154.64	169.36
12.89	150.79	192.52
17.85	147.24	215.78
22.78	143.87	239.07
27.70	140.56	262.31
32.65	137.17	285.46
3.34	153.85	170.17
8.25	149.91	193.35
13.07	146.31	216.62
17.84	142.93	239.94
22.60	139.60	263.22
27.35	136.18	286.40
6	5	
34.74	159.46	164.56
45.25	157.08	186.82
56.03	154.74	209.06
67.03	152.44	231.26
78.17	150.19	253.38
89.38	148.00	275.42
34.03	151.83	163.59
44.20	148.95	185.84
54.74	146.12	208.06
65.55	143.33	230.23
76.52	140.60	252.32
87.53	137.91	274.33
33.18	145.06	162.78
43.15	142.24	185.08
53.57	139.50	207.34
64.32	136.82	229.53
75.24	134.18	251.65

86.16	131.57	273.69
32.32	137.89	161.91
42.10	135.32	184.29
52.44	132.84	206.60
63.15	130.42	228.84
74.03	128.05	251.00
84.91	125.70	273.09
31.59	129.07	160.77
41.10	126.51	183.21
51.27	124.06	205.56
61.86	121.69	227.83
72.62	119.36	250.03
83.36	117.04	272.14
6	5	
3.55	152.39	169.91
8.21	149.72	193.33
12.95	146.58	216.69
17.73	143.16	240.00
22.50	139.69	263.25
27.24	136.36	286.45
4.74	144.20	168.48
9.85	138.47	191.35
14.76	134.07	214.49
19.56	130.48	237.77
24.31	127.20	261.06
29.08	123.70	284.23
6.31	133.36	166.58
11.86	124.58	188.92
16.95	118.96	211.84
21.78	115.23	235.10
26.49	112.16	258.42
31.28	108.48	281.56
8.00	121.70	164.53
13.99	109.88	186.34
19.26	103.02	209.05
24.11	99.14	232.28
28.80	96.26	255.63
33.61	92.42	278.74
9.54	111.05	162.66
15.98	96.16	183.93
21.44	88.03	206.42
26.31	83.96	229.62
30.97	81.27	253.00
35.81	77.22	276.08
6	5	
31.33	129.42	160.88
40.41	127.39	183.48

50.32	125.11	205.91
60.82	122.70	228.19
71.66	120.32	250.36
82.59	118.07	272.45
29.66	102.93	157.36
38.33	100.45	179.98
47.62	97.81	202.48
57.35	95.09	224.88
67.31	92.38	247.18
77.35	89.78	269.40
28.64	74.80	153.47
36.59	71.35	176.10
44.93	67.83	198.66
53.56	64.27	221.17
62.34	60.72	243.59
71.16	57.23	265.93
27.26	43.64	149.21
34.42	39.63	171.92
41.78	35.64	194.62
49.27	31.64	217.29
56.81	27.66	239.90
64.37	23.69	262.43
24.48	8.05	144.60
31.11	4.84	167.53
37.71	1.71	190.51
44.28	-1.37	213.50
50.82	-4.42	236.45
57.35	-7.52	259.32

Appendix F

Program Unite Documentation

```
UNITE.DOC
C
C     THIS IS A DOCUMENTATION FILE DETAILING THE PREPARATION OF
C     FILES FOR RUNNING THE PROGRAM UNITE.
C
C     FILES NEEDED:      SHPHL.DAT
C                        PREF(N).USE/GOM
C                        PREF(N).MMD      (OPTIONAL)
C                        PREF(N).LOD      (OPTIONAL)
C
C     THE PREF(N) FILES ARE THE "N" INDIVIDUAL STRUCTURE FILE NAMES
C     TO BE UNITED. THE GEOMETRIC DATA MUST BE AVAILABLE IN EITHER THE
C     PREF(N).GOM OR THE PREF(N).USE FILE.
C
C     THE PREFX.DAT FILE SHOULD CONTAIN THE FOLLOWING INFORMATION
```

```
C     (FREE FORMAT EXCEPT WHERE NOTED) IN THE FOLLOWING SEQUENCE :
C
C     CARD1: PREFN,TOLL (A5,E10.3)
C            THE 5 CHARACTER FILENAME IDENTIFYING THE VAST PREFIX
C            FOR THE SUBSTRUCTURE FILES TO BE CREATED BY UNITE
C            AND THE TOLERANCE TO BE USED TO FIND COMMON NODES.
C     CARD2: THE TITLE TO BE WRITTEN TO THE NEW PREFN.GOM FILE
C     CARD3: THE NUMBER OF SUPERELEMENT LEVELS (currently 1 in SHPHUL)
C     CARD4: THE NUMBER OF INDIVIDUAL FILES TO BE UNITED
C     CARD5: PREF(1)
C       |       |
C       |       |
C       |       |
C      END : PREF(N)
```

Appendix G

Model Size Parameter Control

The model size that can be generated by SHPHUL is controled by the parameters shown in this listing of file SHPHUL.PAR. The size can be reduced or increased by changing the values for NSMAX, NPMAX, NBMAX, and, NFMAX.

```
      PARAMETER (NSMAX=30,NPMAX=20,NBMAX=20,NFMAX=30
     #,NBPMAX=NSMAX*20,NPPMAX=NPMAX*12,NPNMAX=NBMAX*NFMAX,NBTMAX=20)
C     NSMAX = NUMBER OF BODY PLAN SECTION LINES
C     NPMAX = NUMBER OF PANELS IN ONE SECTION ARROUND THE HULL
C             INCLUDES DECKS, HULL SIDE, AND LONGITUDINAL BULKHEADS.
C     NBMAX = NUMBER OF LONGITUDINAL BEAMS IN A PANEL
C     NFMAX = NUMBER OF TRANSVERSE FRAMES IN A PANEL
C     NBPMAX = NUMBER OF BODY PLAN COORDINATES, NSMAX LINES WITH 20 POINTS
C              EACH IS ASSUMED AS A MAXIMUM.eg. NSMAX * 20 = 600
C     NPPMAX = NUMBER OF POINTS DEFINING THE PANELS IN ONE SECTION
C              PANELS ARE DEFINED BY 4 OR 12 POINTS FOR EACH PANEL.
C     NPNMAX = NUMBER OF NODES GENERATED ON A PANEL, DEFINED BY THE BEAM
```

```
C               FRAME GRID.
C      NBTMAX = NUMBER OF BEAM TYPES USED TO DEFINE ALL BEAMS IN THE SHIP.
```

Appendix H

Procedure For Digitizing Body Plan

The following is the procedure for digitizing bodyplan lines of form when tabular data is not available. It assumes the availability of one of three Tektronix digitizing tablets. Place the lines plan on the digitizing tablet. Assign deck numbers to the lines showing the deck side intersects, also assign interest point numbers to lines across the plan for such items as major longitudinal side beam locations.

```
 Determine and mark convenient command box locations for five tablet
commands. Which will be STOP ENTRY, END LINE, DECK POINT, INTEREST POINT,
and ERROR.

run program SHPHUL
WHAT IS THE TERMINAL LINE SPEED
9600

 WHAT TERMINAL IS BEING USED ?
 TYPE 1 FOR 4010
 TYPE 2 FOR 4014 OR 4015
 TYPE 3 FOR 4113
 TYPE 4 FOR 4211
4

Tablet type number is located on the top left corner of
the tablet frame.

WHAT DIGITIZING TABLET IS TO BE USED ?
TYPE 3 FOR 4953, 4 FOR 4954, 6 FOR 4956,  8 FOR 4958
```

```
0 NO TABLET
8

PLEASE SELECT A POINT ON THE TABLET SURFACE

 This point is used for tablet initialization only and may be
located anywhere on the active tablet surface.

THIS PROGRAM GENERATES 3 DIMENSIONAL SHIP STRUCTURE IN THE
FORM OF ASSEMBLED GRILLAGE PANELS BETWEEN SELECTED END FRAMES
** ENTER DATA STARTING NEAREST THE HULL CENTERLINE AT THE MOST
FWD PANEL EDGE IN A CLOCKWISE DIRECTION

ENTER A FIVE CHARACTER NAME FOR BODY PLAN OFFSET FILE
QESDG

CHOOSE FROM THE FOLLOWING
 1 = NEW SECTION
 2 = PLOT EXISTING SECTION OR CREATE VAST FILE
 3 = EDIT EXISTING MODEL
 4 = ADD TO EXISTING MODEL
 5 = EXAMINE OR EDIT BEAM DATA FILE
 6 = CREATE NEW MODEL FROM EXISTING PANELS
 7 = MIRROR AN EXISTING SECTION
 8 = PLOT ASSEMBLY OF EXISTING SECTIONS
 9 = MODEL BULKHEAD AT GENERATED FRAME LOCATION
10 = GENERATE A PATRAN MODEL
11 = CREATE VAST GEOMETRY FILES OF HULL SECTIONS FOR SUBSTRUCTURING
12 = CREATE INDIVIDUAL SECTION MODEL VAST GOM FILES
13 = STOP
1

SHIP NAME FOR BEAM DATA = CNAV QUEST
0 = CONTINUE
1 = CHANGE NAME
0

ENTER C FOR DATA ENTRY BY CURSER
      T TABLET DATA
T

WHAT IS THE GLOBAL PLANE OF THE STRUCTURAL DRAWING.
     ENTER 1 FOR X Y PLANE (TRANSVERSE STRUCTURE)
     ENTER 2 FOR X Z PLANE (FLAT DECK STRUCTURE)
     ENTER 3 FOR Z Y PLANE (VERTICAL LONGITUDINAL STRUCTURE)
1
```

```
 At present option 1 is the only compatible entry
for SHPHUL data file.

WHAT ARE THE UNITS OF MEASURE?
 IN.  FT.  MM.  M.
IN.

SPECIFY TWO POINTS A KNOWN DISTANCE A PART ON THE
DRAWING TO DEFINE THE SCALE. (LEFT TO RIGHT OR BOTTOM TO TOP)


 ENTER THE DISTANCE BY THE KEYBOARD IN IN.
252

SPECIFY LOWER LEFT AND UPPER RIGHT CORNERS
OF THE DRAWING AREA ON GRAPHICS TABLET.

SPECIFY A REFERENCE POINT WITH KNOWN X AND Y COORDINATES.

ENTER THE X (POSITIVE RIGHT), Y (POSITIVE UP)
COORDINATES OF THE REFERENCE POINT IN IN.
0 0

SPECIFY A LOWER AND AN UPPER POINT ON A LINE PARALLEL
 TO THE VERTICAL AXIS OF THE DRAWING.

DOES THIS LINE GO THROUGH THE REFERENCE POINT IN
THE PLANE OF THE DRAWING?  ( ENTER Y OR N )
Y

DEFINE AND LOCATE THE BOTTOM LEFT AND TOP RIGHT OF
COMMAND BOXES ON THE TABLET SURFACE FOR THE FOLLOWING COMMANDS:

STOP ENTRY

 Select the corner points of the command box STOP ENTRY .
This command box ends tablet input when selected.

END LINE

 Select the corner points of the command box END LINE .
This command box ends definition of a section line.

DECK POINT

 Select the corner points of the command box DECK POINT .
This command box sets a flag to locate an intersection with a deck
```

at the next data point.

INTEREST POINT

Select the corner points of the command box INTEREST POINT . This command box sets a flag to locate a non deck point of structural interest.

ERROR

Select the corner points of the command box ERROR . Last selection was in error.

DISPLAY ALREADY DEFINED LINES (Y OR N)
Y

ENTER LINES OF FORM IN ASCENDING ORDER
MAXIMUM 20 POINTS PER LINE
PRESS RETURN

If 20 points are selected the next section line will be prompted for.

INPUT STATION 1

The selected points describing the first station line are digitized until a point is about to be entered that requires an interest flag, or a deck flag. These are single digit integer numbers.

ENTER INTEREST POINT NUMBER
1

ENTER DECK NUMBER
2

ENTER INTEREST POINT NUMBER
2

ENTER DECK NUMBER
1

ENTER DECK NUMBER
3

END LINE is selected after the last point on the line is digitized.

INPUT STATION 2

```
ENTER INTEREST POINT NUMBER
1

ENTER DECK NUMBER
2

ENTER INTEREST POINT NUMBER
2

ENTER DECK NUMBER
1

ENTER DECK NUMBER
3

INPUT STATION  4

DEFINE SECTION LINE LOCATION FACTORS ( Y OR N )
MUST BE DONE IF THERE ARE LINES FORWARD OF THE FWD.
PERPENDICULAR OR LINES ARE NOT ALL EQUALLY SPACED
Y

LOC=
1.0

LOC=
2.0

ENTER A COORDINATE FILE TITLE (70 CHAR. MAX.)
 LINES DEMO
ENTER LENGTH OF HULL IN
2000

ENTER HULL MODEL SECTION NUMBER.
SECTION NUMBERS MUST FOLLOW IN SEQUENCE FROM THE BOW
TO A MAXIMUM OF 30. THEY MAY BE ENTERED IN ANY ORDER
** ENTER S TO STOP **
S

FORTRAN STOP
```

Appendix I

Additional Graphic Displays Of Model

Additional graphic displays of the assembled model are provided for more insight into the model construction. The figures are hard copies of screen displays generated on a Silicon Graphics Iris work station which provides hidden line removal and shading options. Figure I.1 shows an assembled half model without hidden line removal. Figure I.2 shows the same view with the hidden lines removed. The interior modelling with the bulkheads in place is shown in Figure I.3. The model after mirror imaging is shown shaded in Figure I.4.

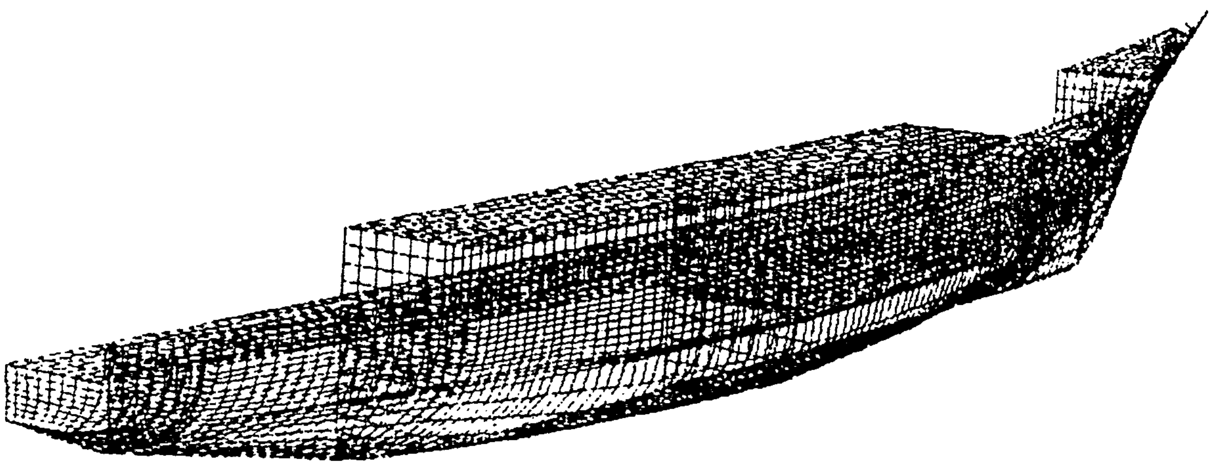

Figure I.1: View Of Half Model

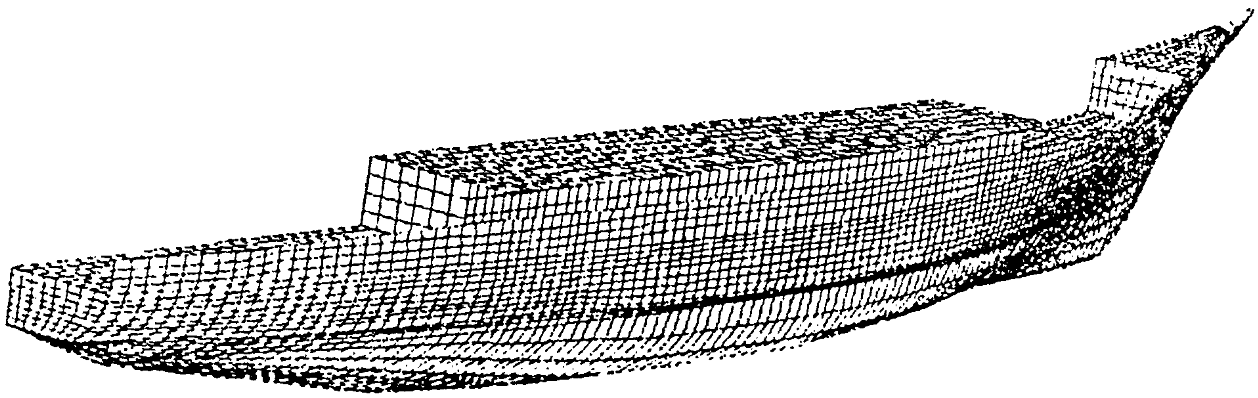

Figure I.2: View Of Half Model With Hidden Line Removal

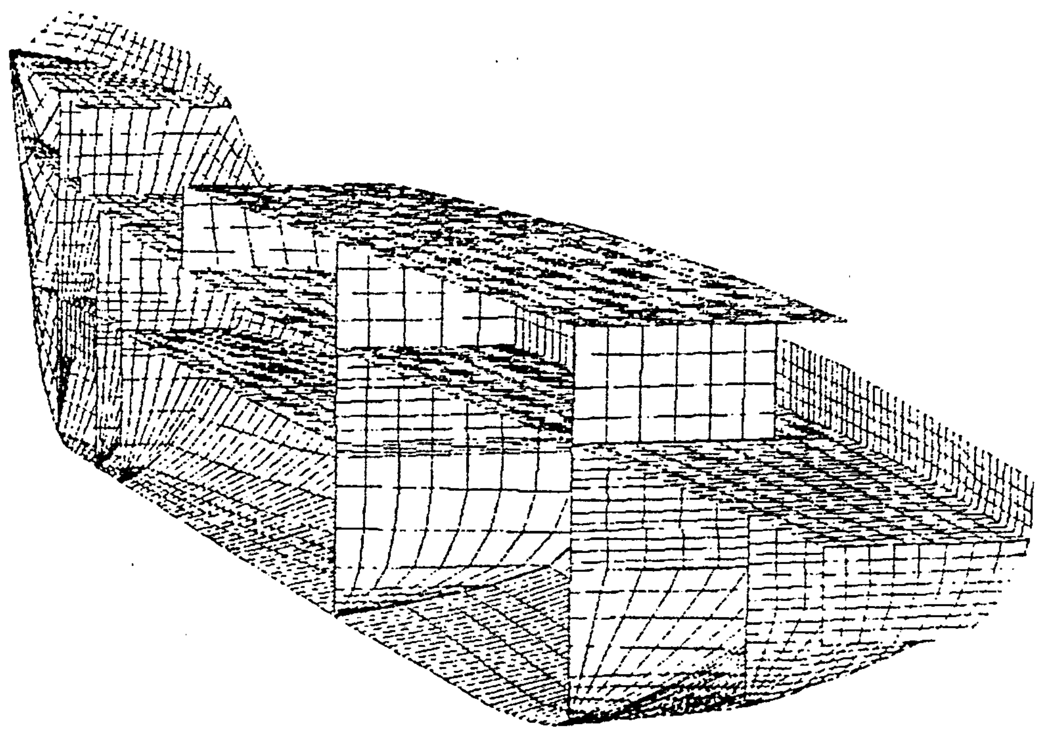

Figure I.3: View Showing Interior Bulkheads

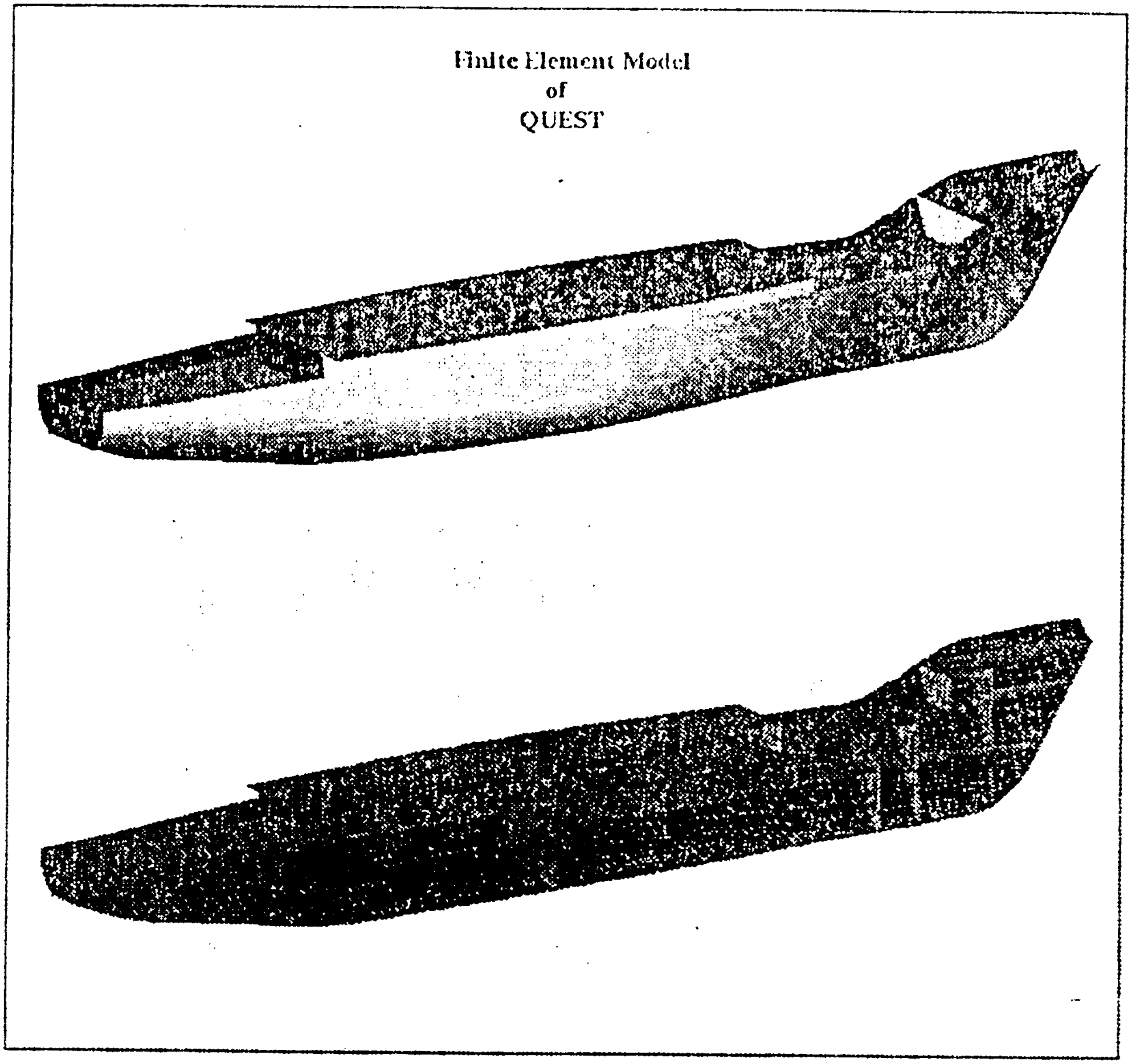

Figure I.4: View Of Mirrored Model With Shading

Appendix J

Procedure For Loading Program

The command for loading SHPHUL on a VAX 6420 is;

```
$FOR/NOOPT SHPHUL.FOR

$FOR/NOOPT SHPHUS.FOR

$FOR/NOOPT FIGURE.FOR

$LINK SHPHUL,PS1:[HYDRO.MACFARLANE]SHPHUS,FIGURE,FACLTY,PL4113-

,TABOPR,PS9:[SOURCE.VASTG.V06]PLOT10/LIB
```

where

SHPHUS is a subprogram for digitizing and editing the body plan coordinates.

FIGURE is a subprogram containing the graphic display of standard hull loads.

FACLTY defines the attributes of the terminal or tablet chosen.

PL4113 defines dialog and screen color control for Tektronix color terminals.

TABORPR contains the tablet commands.

PLOT10/LIB is the library of graphics subroutines for Tektronix PLOT10 graphics system.

PS9:[SOURCE.VASTG.V06] is the file location chosen for locating the graphics library.

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SHPHUL generates finite element models of a ship hull from body plan coordinates. The model is generated by dividing the hull into a number of sections based on groupings of the body plan contour lines displayed on a terminal screen. Each section is modelled by the use of 4 or 12 noded panels. The 4 noded panels can be skewed or warped between body plan lines. Curvature is represented by the use of the 12 noded panels. The nodes are located with a terminal cursor after body plan contours are selected and displayed on the terminal screen. The panels are then gridded with predefined beams representing frames and longitudinal beams and triangular or rectangular plate elements. Each gridded panel can be made a substructure Then each hull section is formed as a series of substructures. Transverse and longitudinal bulkheads are formed in a similar manner. Each panel is reduced to master nodes at section boundaries. All the sections are assembled to form the total hull model. An option within the program will generate each section and bulkhead as an individual unsubstructured finite element model which can be assembled later as a single total structural model. The finite element model files created are in the format required by the finite element program VAST thus enabling a structural analysis to be performed as defined by the loading conditions. SHPHUL can generate hydrostatic pressure loads due to still water and balance-on-a-wave waterlines. Boundary conditions can be applied and three types of added fluid mass model can be created for the hull. This report includes a user's manual and example terminal sessions.

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